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**SPRING OUTMIGRATION OF WILD AND HATCHERY
CHINOOK SALMON AND STEELHEAD TROUT SMOLTS
FROM THE IMNAHA RIVER, OREGON,
FEBRUARY 6-JUNE 20, 1995**

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ABSTRACT

For the second consecutive year, the Nez Perce Tribe, in conjunction with the Fish Passage Center, participated in the smolt monitoring program in the Imnaha River. A rotary screw trap was used to collect emigrating wild and hatchery chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Oncorhynchus mykiss) smolts from February 6 to June 20, 1995.

We PIT tagged and released 421 wild chinook salmon smolts, 747 hatchery chinook salmon smolts (445 HxW and 302 HxH), 227 wild steelhead trout smolts and 1,296 hatchery steelhead trout smolts. Cumulative interrogation rates at mainstem Snake and Columbia River dams were 78.4% for wild chinook salmon, 58.9% for hatchery chinook salmon (HxW), 56.6% for hatchery chinook salmon (HxH), 76.2% for wild steelhead trout, and 69.2% for hatchery steelhead trout.

Peak outmigration of NPT tagged wild Imnaha River chinook salmon smolts occurred from early to mid-May at Lower Granite, Little Goose, and Lower Monumental Dams. Median and 90% passage dates for wild chinook salmon smolts at Lower Granite Dam were May 1 and May 11, respectively. Continuous spill at Lower Granite Dam was initiated on May 3 and lasted for 51 days. The 90% passage date of wild chinook salmon smolts at Lower Granite Dam (May 11) preceded peak Snake River and Lower Granite (June 6) flows by 26 days. Although hatchery chinook salmon exhibited a shorter outmigration period through the Snake River than their wild counterparts, peak arrival for both groups occurred at approximately the same time. Median and 90% passage dates at Lower Granite Dam for other PIT tagged groups were: hatchery chinook salmon (NPT-HxW) - May 2 and May 13; hatchery chinook salmon (FPC-HxH) - May 8 and May 15; wild steelhead trout - May 2 and May 9; and hatchery steelhead trout (NPT and FPC) - May 31 and June 16. Hatchery steelhead trout displayed small peaks in arrival timing at Lower Granite and Little Goose Dams in mid-May to mid-June, however, the general trend at each dam was a long protracted emigration.

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INTRODUCTION

The Nez Perce Tribe (NPT) conducted a smolt monitoring study on the Imnaha River in cooperation with the Fish Passage Center (FPC) in 1995. This study was designed to provide the FPC with information necessary to conduct the annual Smolt Monitoring Program (SMP), which is mandated in the Northwest Power Planning Council's (NPPC) Program for Water Budget and spill management. Information collected will be used to guide future decisions for flow and spill management in the Snake River and proposed drawdowns of Lower Granite Reservoir.

The Pacific States Marine Fisheries Commission contracted the Nez Perce Tribe (NPT) to monitor outmigration timing and PIT (passive integrated transponder) tag 1,000 actively outmigrating hatchery chinook salmon smolts (*Oncorhynchus tshawytscha*), and 2,000 wild and hatchery steelhead trout smolts (*O. mykiss*) from the Imnaha River during the spring outmigration period (March 10 - June 20). Wild chinook salmon smolts were PIT tagged as part of a separate NPT investigation during this same period.

The objectives of this study were to:

1. Determine spring outmigration timing of chinook salmon and steelhead trout smolts collected at the Imnaha River trap.
2. Evaluate effects of flow, smolt condition and other environmental factors on outmigration timing.
3. Collect biological information on Imnaha River emigrants, such as length, weight, and condition factors.
4. Determine outmigration timing and/or travel time of PIT tagged hatchery chinook smolts released at the Imnaha Acclimation Pond.
5. Determine arrival timing, travel time and recovery rate (as an index of smolt survival) of hatchery chinook and wild and hatchery steelhead trout smolts PIT tagged from the mouth of the Imnaha River to Snake and Columbia river dams.

METHODS

Study Area Description

The Imnaha River subbasin is located in northeastern Oregon (Figure 1) and encompasses an area of approximately 2,538 square kilometers. The mainstem Imnaha River flows in a northerly direction for 129 km from its headwaters in the Eagle Cap Wilderness Area (ECWA) to its confluence with the Snake River at river kilometer (rkm) 308.4 (James 1984; Kucera 1989). The river drains the eastern escarpment of the Wallowa mountains and part of an adjacent plateau located between the Wallowa River drainage to the west and Hells Canyon of the Snake River to the east (Kucera 1989). Elevations in the watershed vary from 3,048 m at the headwaters to about 260 m in lower elevations (Kucera 1989).

The 64 year (1929 - 1993) mean annual discharge of the Imnaha River is 172 cms (6,060 cfs) at Imnaha, Oregon, USGS gauge 13292000. Maximum river discharge generally occurs from April to June with minimum flows from August to February (Kucera 1989).

Equipment Description

A floating rotary screw trap manufactured by E.G. Solutions Inc., Corvallis, Oregon, was used to capture outmigrating salmonid smolts for this study. Similar traps have been used to capture migrating salmonid species in New York and Alaska (Kennen et al. 1994; Thedinga et al. 1994). The trap consisted of a non-standard 2.1 m diameter trapping cone supported by a metal A-frame and two six meter pontoons that provided flotation (Figure 2). Fish entering the trapping cone move through to a custom oversize livebox (1.68 m wide x 1.25 m long x 0.55 m deep). The livebox was fitted with a removable baffle to dissipate water velocity during high flows (Figure 2).

Water temperature information for this study was collected using a constant recording Ryan TempMentor which was located approximately 150 m upstream from the trap.

Discharge information used in this report was provided by the U.S. Geological Survey, USGS gauge 13292000 at Imnaha, Oregon (rkm 32).

Trap Operations

Trapping for the SMP project began on March 10, 1995 and was completed on June 20, 1995. The trap was operated 24 hours a day, five days a week during this period. Exceptions to this occurred on several occasions when trap repair was necessary or high flows or debris load in the river precluded safe trap operation.

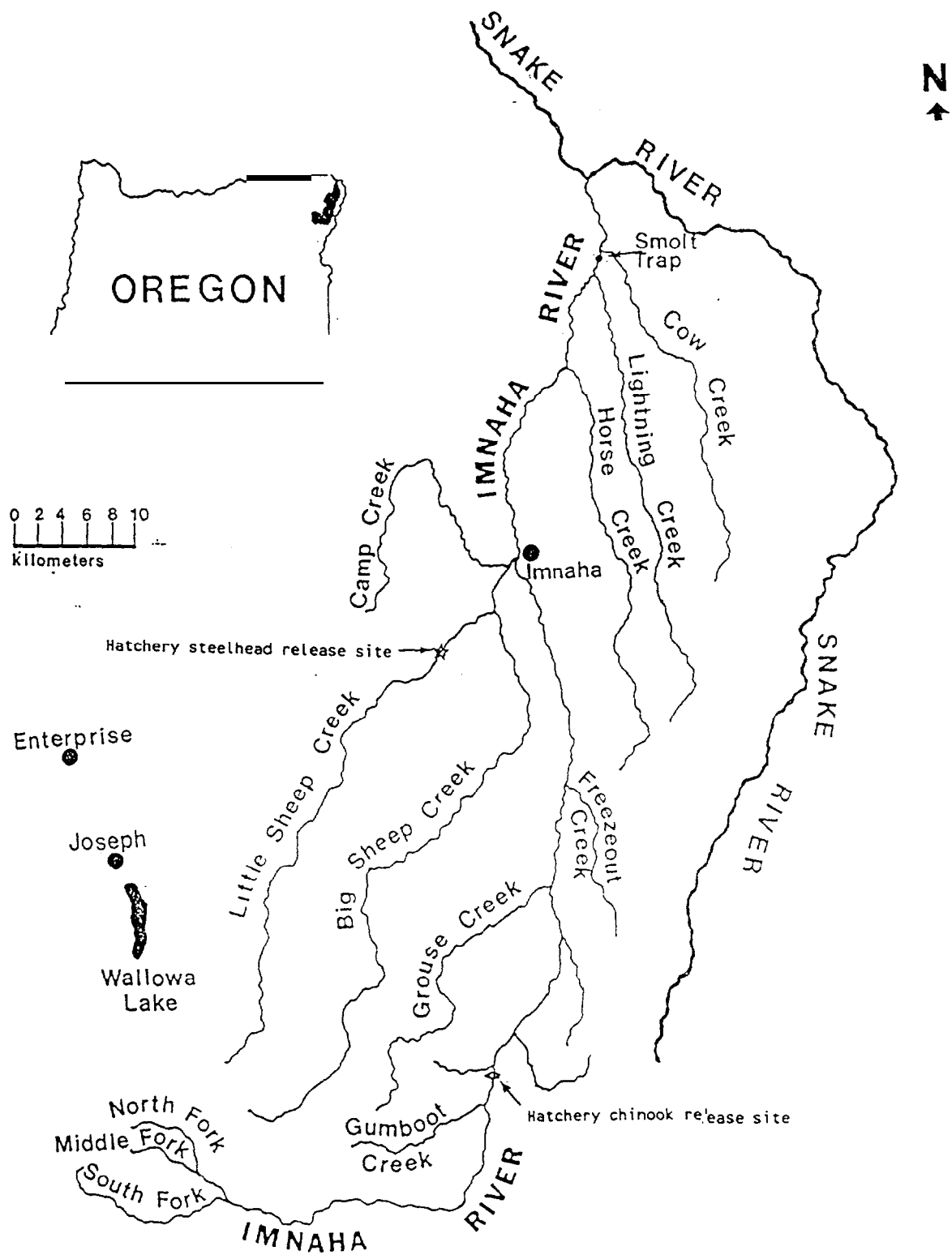


Figure 1. Map of study area.

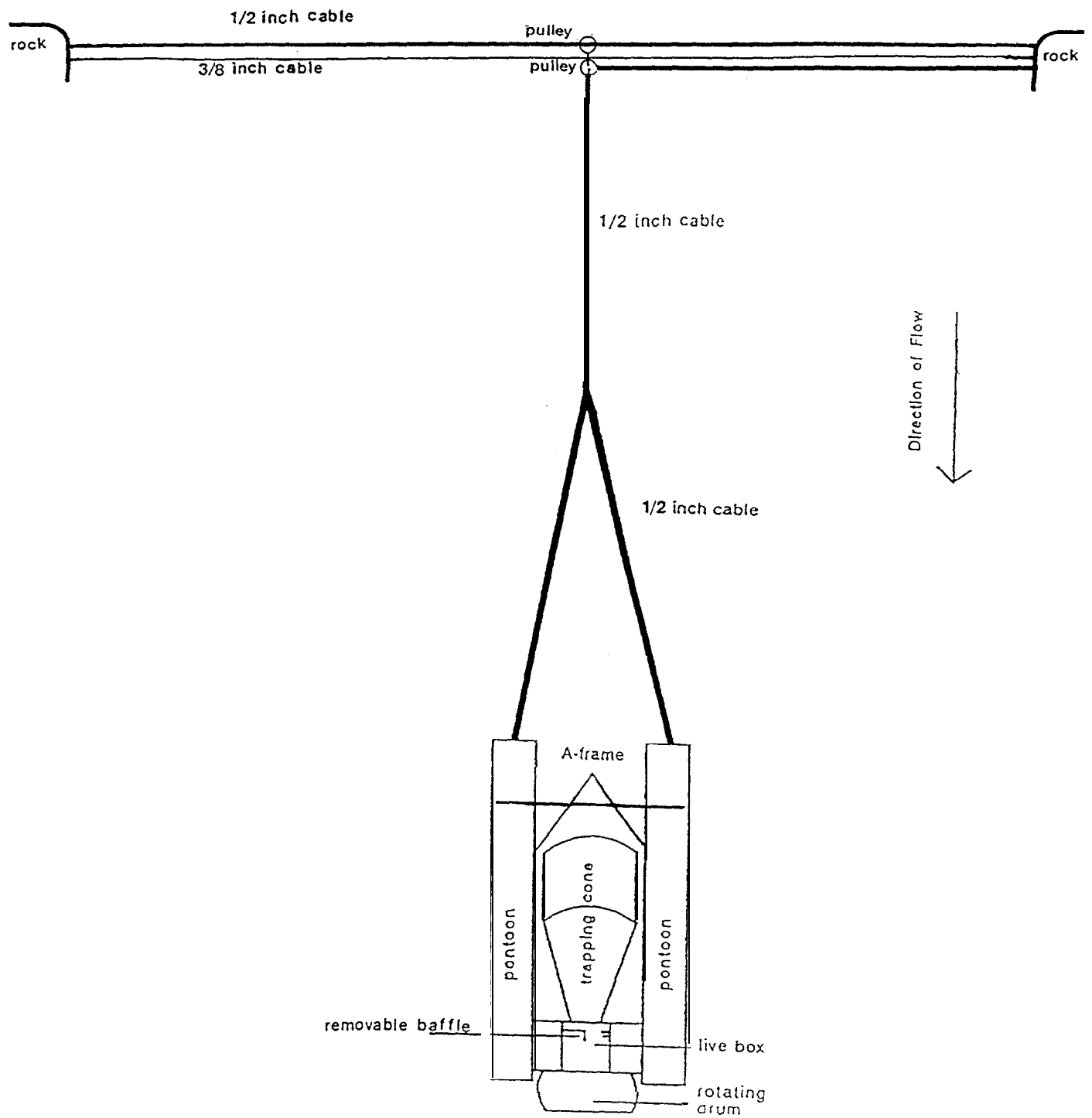


Figure 2. Diagram of screw trap.

The floating rotary screw trap was secured on the west shore of the Imnaha River, below the Cow Creek bridge, 6.6 kilometers from the confluence with the Snake River (Figure 1). The trap position in the river was adjusted by manipulating a cable suspension system (Figure 2) which allowed side to side and upstream/downstream movement of the trap. This setup allowed the trap to be backed slightly out of the main current and fished during high flows. The trap was fished in one of three positions depending on daily readings from the staff gauge located approximately one kilometer upstream of the trap (Table 1).

Table 1. Position in which screw trap was fished dependent upon staff gauge reading.

Staff Gauge	Trap Position
< 0.9 m	Forward
0.9 - 1.0 m	Intermediate
> 1.0 m	Rear

The livebox of the screw-trap was checked at 0800 every morning and several times throughout each night and day. Piscivorous fish and large numbers of incidentally captured fish were removed from the livebox first. Piscivorous fish were scanned for PIT tags and then released 30-50 meters downstream. Wild juvenile chinook salmon were processed first, followed by hatchery chinook salmon (HxW crossed), hatchery chinook salmon (HxH crossed), hatchery chinook salmon (HxH crossed released as parr during the summer of 1994), wild steelhead trout and hatchery steelhead trout smolts, respectively.

Processing procedures were similar to those used by Ashe et al. (1995) and were as follows: 1) Fish were anaesthetized in a MS-222 bath (3 mL MS-222 stock solution (100 g/L) per 19 L of water) buffered with propolyaqua (PRO-NOVAQUA), 2) Each fish was examined for existing marks (e.g. fin clips), and PIT tag insertion scars, 3) Fish with PIT tag scars were scanned with a PIT tag scanner, 4) Up to 200 fish of each group of smolts were selected for trap efficiency trials, 5) A specified number of each species were selected for PIT tag insertion, 6) All other fish were enumerated and released 30-50 m downstream from the trap, 7) Mortality due to trapping was noted and recorded.

Exceptions to this procedure occurred after hatchery releases when upwards of 20,000 fish were captured in one night. On these occasions netfulls of fish were removed from the livebox and released through a remote PIT tag scanner (Biomark model RM-DC400-6) into the river. Catch estimates were made by subsampling 10% of

the total number of netfulls for species number and composition. Fish were held in net pens until being processed.

Trap Efficiency

Trap efficiency trials for each species were conducted as often as possible with the requirement that at least 10 healthy individuals were available. Special efforts were made to conduct trials when changes in stream discharge occurred. Wild and hatchery chinook salmon and wild steelhead trout smolts selected for trap efficiency trials were measured (FL) to the nearest mm, weighed to the nearest 0.1 g, and marked by clipping the distal portion of one of seven possible fins (Table 2).

Hatchery steelhead trout smolts were marked with either a top caudal fin (TCC) or a lower caudal fin (LCC) clips on alternating days. This was necessary due to the erosion or absence of all other fins.

Table 2. Fin clip applied to wild and hatchery chinook salmon and wild steelhead trout smolts used in trap efficiency trials.

Day of the week	Fin clip applied
Sunday	Dorsal fin (DC)
Monday	Top caudal fin (TCC)
Tuesday	Lower caudal fin (LCC)
Wednesday	Left ventral fin (LVC)
Thursday	Right ventral fin (RVC)
Friday	Left pectoral fin (LPC)
Saturday	Right pectoral fin (RPC)

Fish marked for trap efficiency trials were held in covered live nets during daytime hours (approximately 12 h) and then transported upstream approximately one km to the release site during evening hours. Fish were released after dark on the day they were marked.

Trap efficiency was determined by: $E = R/M$

where E is estimated trap efficiency, R is number of marked fish recaptured, and M is number of fish marked and released.

Daily outmigration numbers were estimated by: $N = U/E$;

where N is estimate of total number of emigrants, and U is number of unmarked fish.

Smolt Yield

In 1994, the spring outmigration period was divided into flow periods based on trap efficiency correlated with discharge (Ashe et al. 1995). This year, however, due to the oscillational nature of discharge and insufficient number of trap efficiency trials, flow periods could not be clearly distinguished. Point estimates of smolt yield were determined for each uninterrupted period of data. Total number of fish captured, fish marked, and fish recaptured were summed by species and origin for each uninterrupted period of data. During interruptions of no greater than three days, catch was estimated in equal increments at an ascending or descending rate. Number of fish captured could not be estimated during interruptions greater than three days.

Point estimates of smolt yield were determined for each uninterrupted period of data having sufficient numbers of trap efficiency trials using the bootstrap method (Efron and Tibshirani 1986; Murphy et al. in prep).

Bootstrap period estimates (N_p) were calculated by: $N_p = U_p/E_p$

where U_p is the total number of unmarked fish captured during the period and E_p is the mean trap efficiency for the period. Variance for bootstrap estimates were calculated using a program developed by Murphy et al. (in prep).

Biological Characteristics

Length frequency distributions were created and condition factors calculated for each fish species and origin. Condition factor was calculated using Fulton's condition factor : $(W/L^3) \times 10^5$ (Bagenal and Tesch 1978). Wild steelhead less than 120 mm were believed not to be smolts and therefore were not used in smolt length, weight and condition factor calculations. Two groups of hatchery reared chinook captured at the screw trap were marked with adipose clips and differentiation of these groups proved difficult. One group was released as (HxH crossed) parr in July of 1994 and the other was a (HxW crossed) spring release hatchery chinook. Adipose clipped chinook captured before the spring released hatchery smolts, or less than 90 mm were identified as representing the parr release in 1994. The 90 mm length represented the minimum length of spring pre-release sampled (HxW crossed) hatchery chinook. These parr were not used to calculate biological characteristics of spring released hatchery chinook salmon smolts.

PIT Tagging

Fish selected for passive integrated transponder (PIT) tagging were examined for previous PIT tagging, descaling and general health before being tagged, measured (FL-mm) and weighed (0.1 g). Only healthy fish greater than 65 mm were selected for tagging. Fish were PIT tagged using hand injector units following the general methods described by Prentice et al. (1986, 1990b) and Matthews et al. (1990, 1992). Hypodermic injector units were sterilized after each use in ethanol alcohol for at least 10 minutes prior to tagging. PIT tags were also sterilized for 10 minutes and allowed to air-dry prior to their use. Tagging was discontinued when water temperatures exceeded 15°C.

Weekly tagging goals were set by FPC (Table 3). These goals were modified as the season progressed based upon catch and interruptions in trapping due to equipment repairs. Up to 150 additional wild chinook salmon smolts were tagged each week as part of a separate Nez Perce Tribe (NPT) investigation. Fish tagged for FPC investigations were held for a minimum of one hour after tagging until fully recovered and then released as a group. Fish tagged for NPT investigations were held in net pens for a minimum of 12 hours and released as a group after dark with the exception that hatchery steelhead trout smolts were released one hour after tagging and recovery. The latter methodology is a standard practice employed by the NPT aimed at allowing chinook smolts to recover from tagging stress and increasing predator avoidance. Chinook salmon PIT tagged under FPC investigations were hatchery x hatchery crosses (HxH). Chinook salmon PIT tagged under NPT investigations were hatchery x wild crosses (HxW) with the exception of the April 22 release group which were both HxW and HxH. Tagging methodology was the same for FPC and NPT tagged steelhead. Mortality due to tagging was noted and reported.

Table 3. PIT tag schedule for wild and hatchery steelhead trout and hatchery chinook salmon smolts as detailed by the Fish Passage Center.

Species/rearing type	Tagging Dates	Daily Goal	Weekly Maximum
Wild Steelhead	April 17-21	50	200
	April 24-28	50	200
	May 1-5	50	200
	May 8-12	50	200
	May 15-19	50	200
	May 22-26	50	200
Hatchery Steelhead	May 1-5	100	200
	May 8-12	100	200
	May 15-19	100	200
	May 22-26	100	200
	May 29-June 2	100	200
	June 5-9	100	200
Hatchery Chinook (H x H crosses only)	April 10-14	100	200
	April 17-21	100	200
	April 24-28	100	200
	May 1-5	100	200
	May 8-12	100	200
	May 15-19	100	200

Tagging data were proofed for mistakes using PITVAL software program. Tagging and interrogation files were submitted to the Pacific States Marine Fisheries Commission (PSMFC) PIT Tag Information System (PTAGIS) database via modem the day following collection. PIT tag interrogation data were downloaded from the PTAGIS database.

Outmigration timing and travel time of PIT tagged hatchery chinook salmon smolts released at the Imnaha Acclimation Pond and wild chinook salmon parr PIT tagged in the upper Imnaha River was determined by capture and PIT tag interrogation at the rotary screw trap site (Figure 1).

Arrival timing, travel time and recovery rate to Lower Granite Dam through the Snake River to McNary Dam was determined for wild and hatchery chinook salmon and steelhead trout smolts. Release groups of fish were pooled weekly to determine arrival timing and travel time to Lower Granite Dam. First time PIT tag observations, from all dams, were used to calculate and report the cumulative interrogation rate to Lower Granite Dam by species and origin. Cumulative detection rate of each species was determined by dividing the sum of first tag code observations by the total number of fish tagged and released. Single coil detections or negative travel time individual fish were deleted from the analysis. Travel time between mainstem dams was not calculated due to time constraints.

Arrival timing at each dam and travel time to Lower Granite Dam estimates during this report period are based on first-time observations of individual tag codes at each dam. Arrival timing estimates do not include subsequent detections of fish that were captured in the Snake River trap, held in sample rooms or raceways, had negative travel times or single coil detections. Travel time estimates do not include fish captured in the Snake River trap.

RESULTS AND DISCUSSION

Imnaha River Subbasin Outmigration

Imnaha River mean daily discharge during spring outmigration ranged from 7.9 cms (278 cfs) on February 18 to 114.1 cms (4,030 cfs) on May 7 at USGS gauge 13292000, Imnaha, OR (Figure 3). Mean daily water temperatures during the study period ranged from 0.4°C on February 14 to 13.4°C on June 11 (Figure 3). Appendix Table A contains daily discharge readings and daily minimum, maximum and mean water temperatures during the study period.

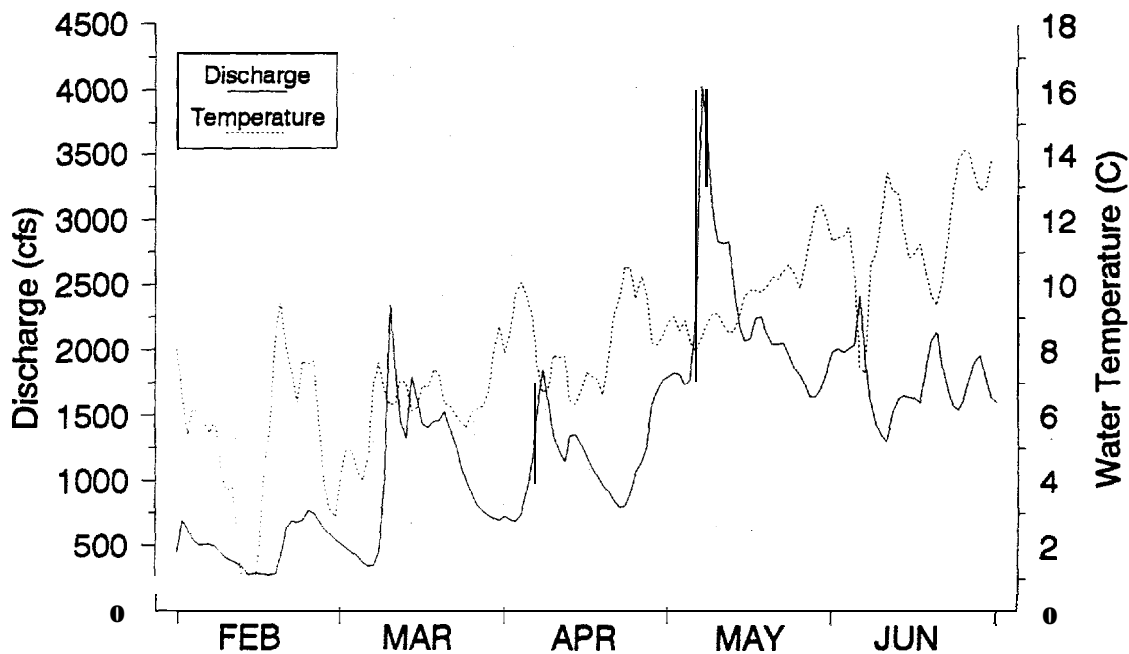


Figure 3. Mean daily discharge (USGS Gauge 13292000 at Imnaha, OR) and mean daily water temperature of Imnaha River during the spring outmigration period, February 1 - June 20, 1995.

Trap Operation

The Imnaha River screw trap was operated for 62 days during the 135 day spring outmigration period (February 6 - June 20). The trap was deployed on Sunday afternoon of each week and was raised on Friday morning following data collection. There were seven occasions (effecting 25 days) during which the trap did not operate continuously. These interruptions were due either to high flows, trap malfunction, or high debris load in the river (Table 4).

A total of 2,430 wild chinook salmon, 74,925 hatchery chinook salmon (63,976 HxW crosses, 10,902 HxH crosses, and 47 HxH crosses released as parr), 789 wild steelhead trout and 7,237 hatchery steelhead trout smolts were captured in the Imnaha River during the study period (Table 5). See Appendix B for daily catch summaries of wild and hatchery fish for both species.

Outmigration Trends

Wild chinook salmon were collected throughout the study period and comprised 3% of the total fish catch. Two pulses in wild chinook smolt outmigration from the

Table 4. Dates the rotary screw trap was not operated during the study period, March 10 – June 20, 1995

Date	Reason
3/11 – 3/12	Weekend
3/13 – 3/21	Trap damaged by debris, being repaired
3/25 – 3/26	Weekend
4/02 – 4/03	Treated as weekend
4/07 – 4/17 ^a	Front shaft on screw broke, being repaired
4/22 – 4/23	Weekend
4/29 – 4/30	Weekend
5/01	Preparing for hatchery steelhead release
5/06 – 5/07	Weekend
5/08 – 5/11	Excessive river flow
5/12	Tribal holiday
5/13 – 5/14	Weekend
5/15 – 5/16	Tribal personnel training
5/20 – 5/21	Weekend
5/27 – 5/28	Weekend
5/29	Tribal holiday
5/30 – 5/31	Screw damaged and screw cable broke, being repaired
6/03 – 6/04	Weekend
6/10 – 6/11	Weekend
6/13	Screw damaged, being repaired
6/16	Tribal holiday
6/17 – 6/18	Weekend

^aFive foot trap was test fished on April 13

Table 5. Weekly catch composition of wild and hatchery chinook salmon and steelhead trout smolts collected in the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Chinook				Steelhead				Total Catch
	Wild	Hatchery (HxW)	Hatchery (HxH)	Hatchery Parr release	Total	Wild	Parr/W	Hatchery	Total
2/05 – 2/11	52	0	0	2	54	2	2	0	4
2/12 – 2/18	4	0	0	0	4	0	0	0	0
2/19 – 2/25	19	0	0	0	19	3	0	0	3
2/26 – 3/04	62	0	0	4	66	3	0	0	3
3/05 – 3/11	7	0	0	1	8	0	0	0	0
3/12 – 3/18 ^a	0	0	0	0	0	0	0	0	0
3/19 – 3/25	129	0	0	3	132	7	0	0	7
3/26 – 4/01	858	55,869	0	31	56,758	115	4	0	119
4/02 – 4/08	539	1,278	6,216	5	8,038	15	1	11	27
4/09 – 4/15 ^b	28	3	27	0	58	0	0	0	0
4/16 – 4/22	286	149	23	1	459	106	0	2	108
4/23 – 4/29	255	6,493	4,553	0	11,301	215	0	2	217
4/30 – 5/06	74	38	49	0	161	118	0	4,829	4,947
5/07 – 5/13 ^a	0	0	0	0	0	0	0	0	0
5/14 – 5/20	35	27	21	0	83	63	2	272	337
5/21 – 5/27	32	33	12	0	77	107	1	1,207	1,315
5/28 – 6/03	10	18	1	0	29	21	12	383	416
6/04 – 6/10	26	30	0	0	56	8	3	319	330
6/11 – 6/17	8	28	0	0	36	6	2	164	172
6/18 – 6/20	6	10	0	0	16	0	1	48	49
Total	2,430	63,976	10,902	47	77,355	789	28	7,237	8,054
Total									85,409

^aTrap not operated.

^bFive foot trap was test fished on April 13.

Imnaha River were observed during the study period. The initial, and largest, pulse in downstream movement occurred from March 28 - 31. An estimated 3,300 fish/day emigrated from the Imnaha River during this period with an actual catch of 710 wild chinook. A second spike in movement was observed on April 6 when 424 wild chinook salmon smolts were captured, however, due to lack of trap efficiency trials, daily run size could not be estimated. These spikes in emigration coincided with the release of hatchery chinook on both occasions. Wild chinook salmon smolts were collected throughout the rest of the study period with 50 wild chinook being caught in June.

Oregon Department of Fish and Wildlife (ODFW) released 590,069 hatchery reared chinook salmon smolts, of which 445,670 (249,856 HxW and 195,814 HxH) were acclimated and 144,399 (HxW) were direct stream released, into the Imnaha River at the Imnaha River Acclimation Pond (rkm 73) (Mike Flesher, ODFW, pers. comm.). Hatchery chinook releases preceded a major increase in river discharge by nine days. ODFW and the Nez Perce Tribe released 283,046 hatchery chinook salmon parr (HxH) into Big Sheep Creek (151,332), Cow Creek (24,260), Freezeout Creek (7,614), Horse Creek (24,160), Imnaha River (36,240), Lightning Creek (24,260) and Little Sheep Creek (15,180) during July of 1994.

Approximately 16% of the hatchery chinook smolts (HxW) were captured during the study period which comprised 74.9% of the total catch. Roughly 5.6% of the hatchery chinook smolts (HxH) were trapped during the study period and comprised 12.8% of the total catch. Parr released fish accounted for 0.05% of the total catch and less than 0.02% of the total released were trapped during the study period. Hatchery chinook salmon smolts from the first release (March 28) were first captured in the trap the same night of release. Approximately 68% of the hatchery chinook salmon released on March 28 were estimated to have emigrated past the trap within six days of release (actual catch of 55,869). Two additional pulses were observed on April 6 and between April 25 - 28 when 6,683 (6,043 HxH, 639 HxW and 1 released parr) and 11,014 (6,463 HxW and 4,551 HxH) hatchery chinook salmon smolts were captured, respectively. These movements were closely associated with additional ODFW releases. Small numbers of hatchery chinook salmon smolts were caught throughout the remainder of the study period. Appendix Table G.1. summarizes the ODFW spring release schedule for hatchery chinook salmon and steelhead trout smolts in 1995. Appendix Table G.2. summarizes the chinook parr (HxH) releases in the Imnaha subbasin during July, 1994.

Wild steelhead trout smolts were first sampled at the trap on February 8. Wild steelhead trout smolts made up 0.9% of the total catch. The peak movement occurred from April 26 - May 3, however, the highest single day catch (80) occurred on March 30. Outmigrating wild steelhead trout smolts were captured throughout the rest of the reporting period, although only small numbers were trapped in June.

ODFW released 338,512 hatchery steelhead trout smolts into the Imnaha River subbasin (Mike Flesher, ODFW, pers. comm). On April 28, 50,676 steelhead trout smolts were released at the bridge crossing near Fence Creek (rkm 24.6). On May 1, 287,836 (230,882 acclimated and 56,954 direct stream released) more were released at the Little Sheep Creek Acclimation Pond (rkm 45). Hatchery steelhead trout smolts began arriving at the trap the evening of May 1 as 693 hatchery steelhead trout smolts were captured the morning of May 2. Approximately 7,240 hatchery steelhead trout were collected in the trap between May 1 and June 20. Catch rates peaked on May 3 when an estimated 1,840 hatchery steelhead trout smolts were collected. Hatchery steelhead smolt emigration in 1995, as in 1994 (Ashe et al. 1995), was very protracted. During late June, hatchery steelhead smolts were still being caught at an average of 30 fish per day. Approximately 2% of the hatchery released smolts were captured during the study period and represented 8% of the total catch.

Trap Efficiency and Smolt Yield

Due to excessive stream discharge and trap malfunctions only 36 successful trap efficiency trials were conducted during the spring outmigration period. Mean trap efficiency rates for wild chinook salmon ranged from 10.2% (March 23 - April 1) to 12.9% (March 1 - March 3). Mean trap efficiency rates for hatchery chinook salmon ranged from 9.1% (May 19 - May 26) to 26.4% (April 1 - April 5). Mean trap efficiency rates for wild steelhead trout ranged from 5.7% (May 19 - May 23) to 24.9% (April 19 - April 21). Mean trap efficiency rates for hatchery steelhead trout ranged from 7.6% (May 18 - May 25) to 11.9% (June 2 - June 20). Mark and recapture data for each trap efficiency trial are contained in Appendix C.

Minimal trap efficiency trials were also due, in part, to the large numbers of hatchery chinook salmon smolts trapped within the compressed migration time frame. Sample size requirements for PIT tagging and trap efficiency trials were an additional constraint.

Total smolt yield for wild and hatchery chinook salmon and steelhead trout smolts could not be estimated for the study period. We could, however, derive point estimates of smolt yield for certain species and origins during uninterrupted periods of data where trap efficiency trials were sufficient (Table 6).

The smolt yield point estimate for hatchery chinook between March 28 - April 5 was 221,935 (Table 7) with the highest single day of outmigration occurring on March 30 (Figure 4). This estimate was 68% of the total number released by ODFW on March 28.

Table 6. Number of trap efficiency trials and mean trap efficiency during specific periods for each species.

Species	Period	Trials (n)	Mean Trap Efficiency
Wild Chinook	3/01 – 3/03	3	0.129
	3/23 – 4/01	4	0.102
	3/28 – 4/01	2	0.122
	4/19 – 4/25	2	0.121
Hatchery Chinook	4/01 – 4/05	2	0.264
	4/21 – 4/25	2	0.131
	5/19 – 5/26	3	0.091
Wild Steelhead	4/19 – 4/21	3	0.249
	5/19 – 5/23	2	0.057
Hatchery Steelhead	5/04 – 5/05	2	0.091
	5/18 – 5/25	3	0.076
	6/02 – 6/20	5	0.119

Table 7. Smoltyield point estimates (\pm 95% C.I.) for wild and hatchery chinook salmon and steelhead trout smolts using the bootstrap method (Murphy et al., in prep.).

Species	Period	Estimate	\pm 95% C.I.
Wild Chinook	2/28 – 3/10	a26	1,293
	3/22 – 3/31	10,339	5,582
	4/01 – 4/05	2,531	3,009
	4/18 – 4/25	4,100	7,067
Hatchery Chinook	3/28 – 4/05	221,935	46,894
	4/18 – 4/25	21,644	12,508
	5/17 – 5/26	1,437	2,469
Wild Steelhead	4/18 – 4/25	836	347
	5/17 – 5/26	3,855	7,008
Hatchery Steelhead	5/02 – 5/05	53,152	21,898
	5/17 – 5/26	23,956	10,574
	6/01 – 6/20	13,017	4,930

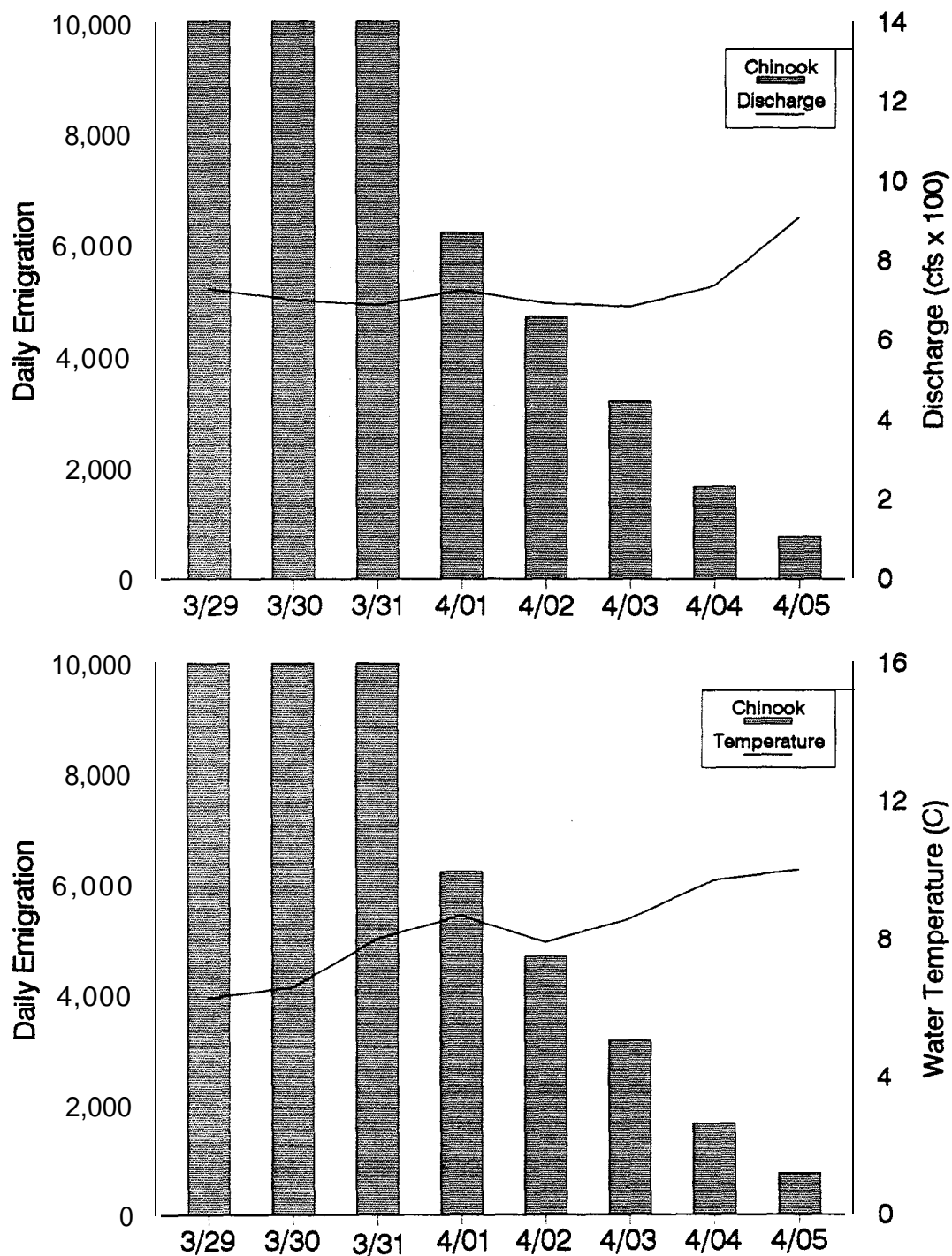


Figure 4. Hatchery chinook salmon smolt (HxW crossed) daily outmigration versus mean daily water discharge (upper graph) and mean daily water temperature (lower graph) from the Imnaha River, March 29 - April 5. Estimated outmigration on March 29 was 31,992; on March 30 was 155,276; and on March 31 was 18,151.

Biological Characteristics

Based on length frequency data the majority of chinook salmon and steelhead trout emigrants collected in the screw trap were age 1⁺ and 2⁺ respectively (Figures 5 and 6). Mean length of wild chinook salmon emigrants was 99 mm, mean weight was 10.7 g, and mean condition factor (K) of 1.07 (Table 8). Weekly mean length of wild chinook salmon throughout the spring outmigration, ranged from 90 to 105 mm (Figure 7). Condition factors of wild chinook salmon ranged from 0.96 to 1.23 with a increasing trend from February to late May (Figure 7).

Hatchery chinook salmon smolts (HxW crossed) were notably larger than their wild counterparts. Mean length was 119 mm, mean weight was 18.9 g, and mean condition factor (K) was 1.09 (Table 8). Mean length and weight may be artificially low since hatchery chinook parr released in 1994 were included in this group because they were also adipose fin only clipped. Weekly mean length of hatchery chinook salmon (HxW) ranged from 105 to 126 mm (Figure 7). Condition factors of hatchery chinook (HxW) ranged from 1.06 to 1.17 and were comparable to wild chinook salmon outmigrating at the same time (Figure 7). ODFW conducted a size at release experiment with hatchery chinook salmon smolts by releasing two size groups; 15 fish/lb. and 25 fish/lb (Mike Flesher, ODFW, pers. comm). We did not observe a bimodal length distribution of HxW crossed hatchery chinook salmon smolts captured in our trap (Figure 5). However, notably larger HxW crossed hatchery chinook smolts were sampled the first two weeks after release on March 28 (mean length of 125 mm) and the week of April 27 (mean length of 124 mm) (Figure 7).

Hatchery chinook salmon smolts (HxH crossed) were also notably larger than wild chinook. Mean length was 127 mm, mean weight was 21.3 g, and mean condition factor (K) was 1.04 (Table 8). Weekly mean length of hatchery chinook salmon (HxH) ranged from 120 to 136 mm (Figure 7) excluding the week ending June 3 when only one fish was captured. Condition factors of hatchery chinook salmon (HxH) ranged from 0.98 to 1.09 and were generally lower than their (HxW) counterparts (Figure 7).

Hatchery chinook that were captured before the spring release of hatchery chinook (HXW crossed) or had a length of less than 90 mm were identified as (HxH crossed) parr that were released in 1994 (See Methods for details). Mean length was 94 mm, mean weight was 9.1 g, and mean condition factor (K) was 1.05.

Wild steelhead trout smolt mean length was 173 mm, mean weight was 52.7 g, and mean condition factor (K) was 0.98 (Table 8). Weekly mean fork length of wild steelhead trout was similar throughout the spring outmigration, ranging from 153 to 185 mm (Figure 8). Condition factors of wild steelhead trout ranged from 0.95 to 1.03 (Figure 8). Wild steelhead trout mean weekly condition factors remained notably higher than their hatchery reared counterparts from the weeks of May 20 through June 17.

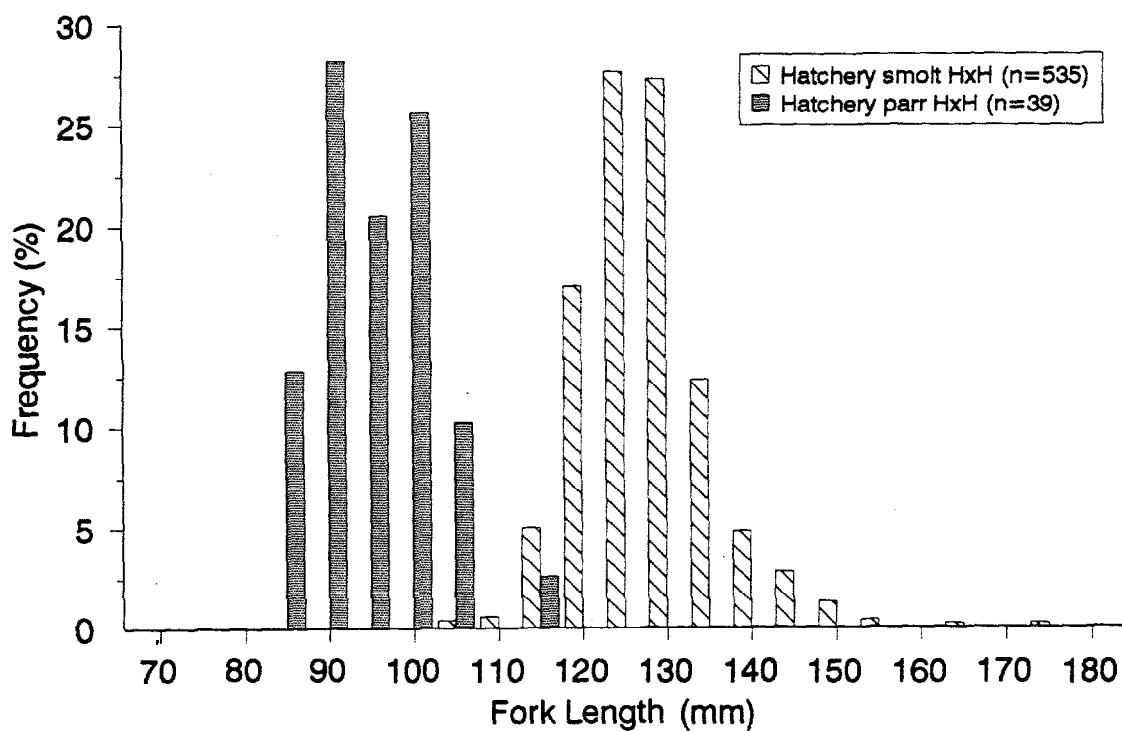
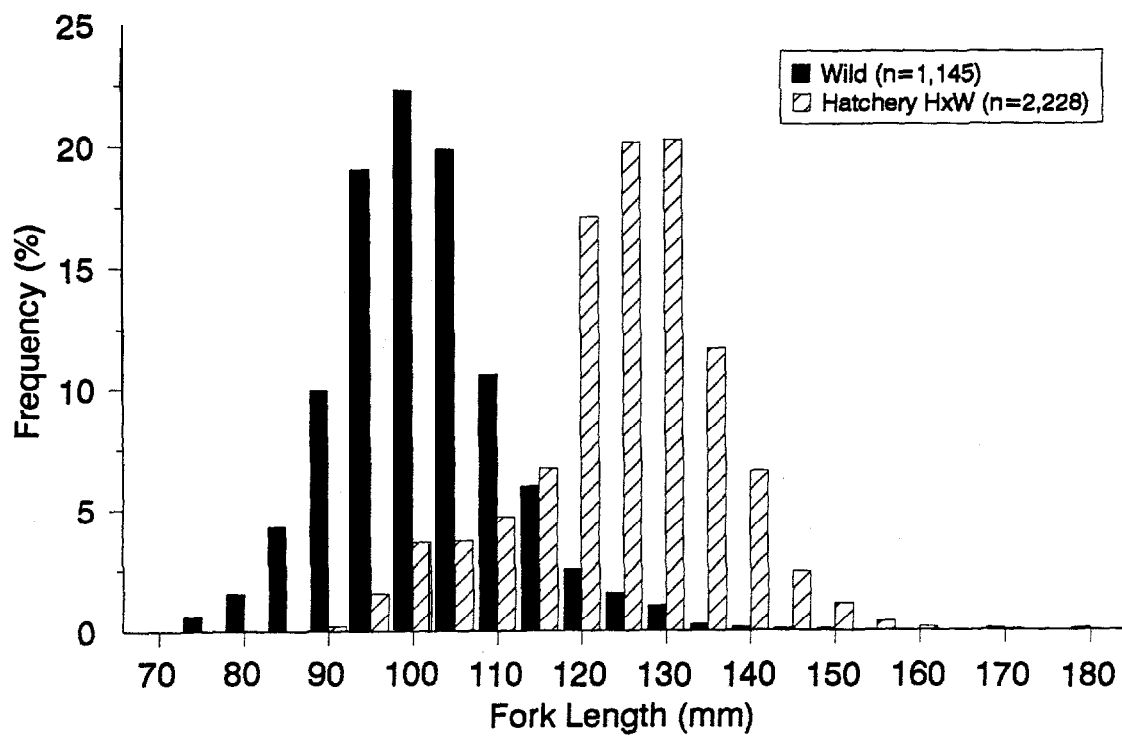


Figure 5. Length frequency of wild and HxW crossed hatchery chinook smolts (upper graph) and HxH crossed hatchery smolts and hatchery parr released chinook (lower graph) salmon smolts trapped in the Imnaha River, February 6 - June 20, 1995.

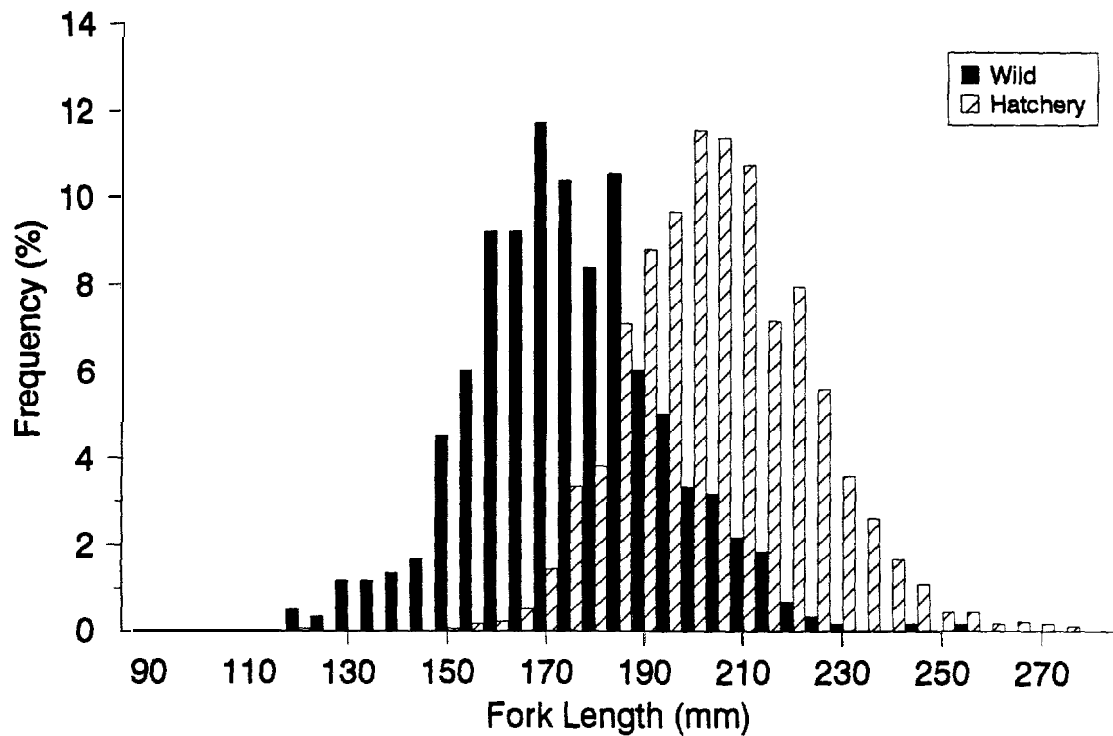


Figure 6. Length frequency of wild (n=597) and hatchery (n=1,752) steelhead trout **smolts** trapped in the Imnaha River, February 6 - June 20, 1995.

Table 8. Mean fork length (mm), weight (g), and condition factor (K) of wild and hatchery chinook salmon and steelhead trout smolts collected in the Imnaha River screw trap, February 6 – June 20, 1995.

Species/ Rearing Type	n	Mean Fork Length	Standard Deviation	Mean Weight	Standard Deviation	Mean K	Standard Deviation
Chinook-W	1003	99	9.8	10.7	3.4	1.07	0.11
Chinook-HxW	898	119	11.4	18.9	5.0	1.09	0.09
Chinook-HxH	391	127	8.3	21.3	4.5	1.04	0.09
Chinook-Parr	34	94	6.6	9.1	2.3	1.05	0.07
Steelhead-W	568	173	19.5	52.7	18.2	0.98	0.08
Steelhead – H	1537	208	18.5	86.1	25.6	0.93	0.08

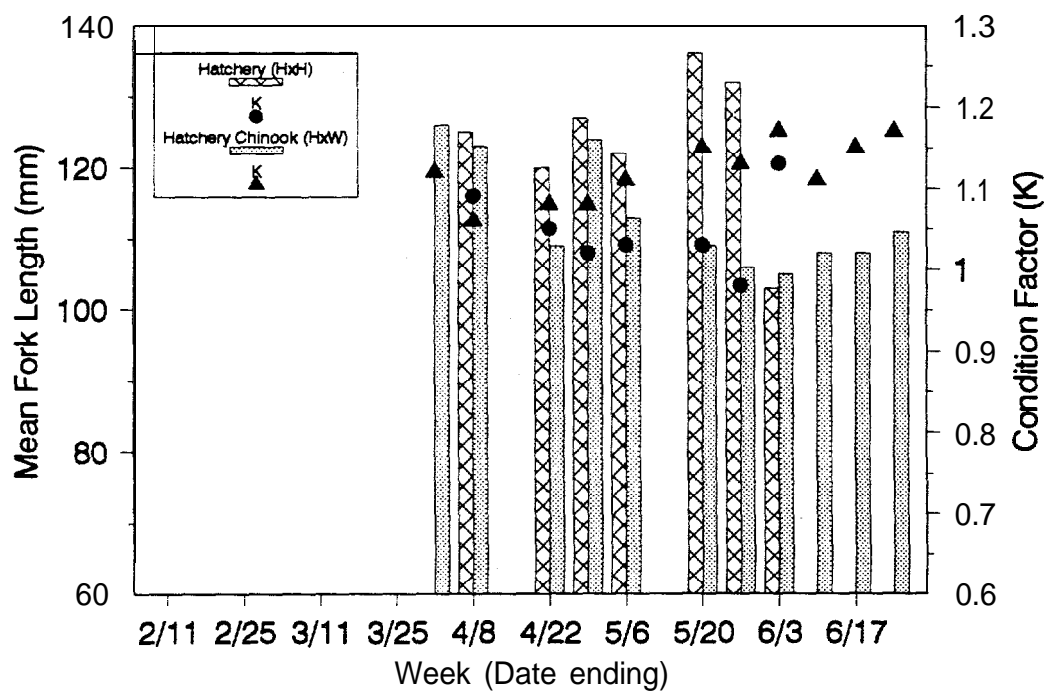
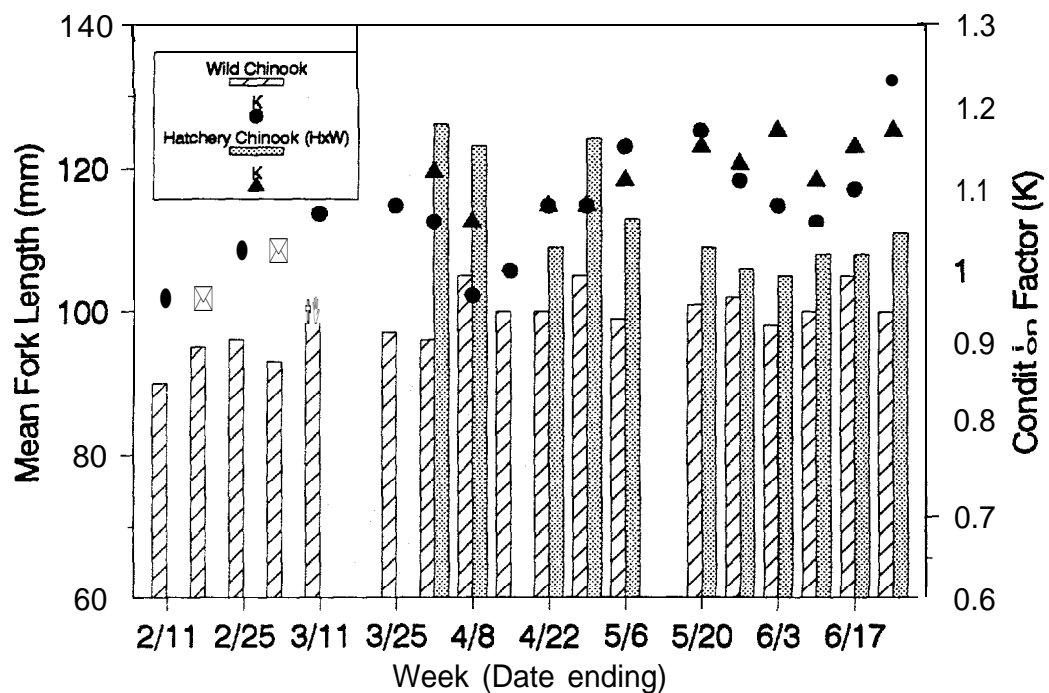


Figure 7. Weekly mean length and condition factor of wild and hatchery chinook (HxW crossed) salmon smolts (upper graph) and hatchery chinook (HxW crossed) and (HxH crossed) salmon smolts (lower graph) trapped in the Imnaha River, February 6 - June 20, 1995.

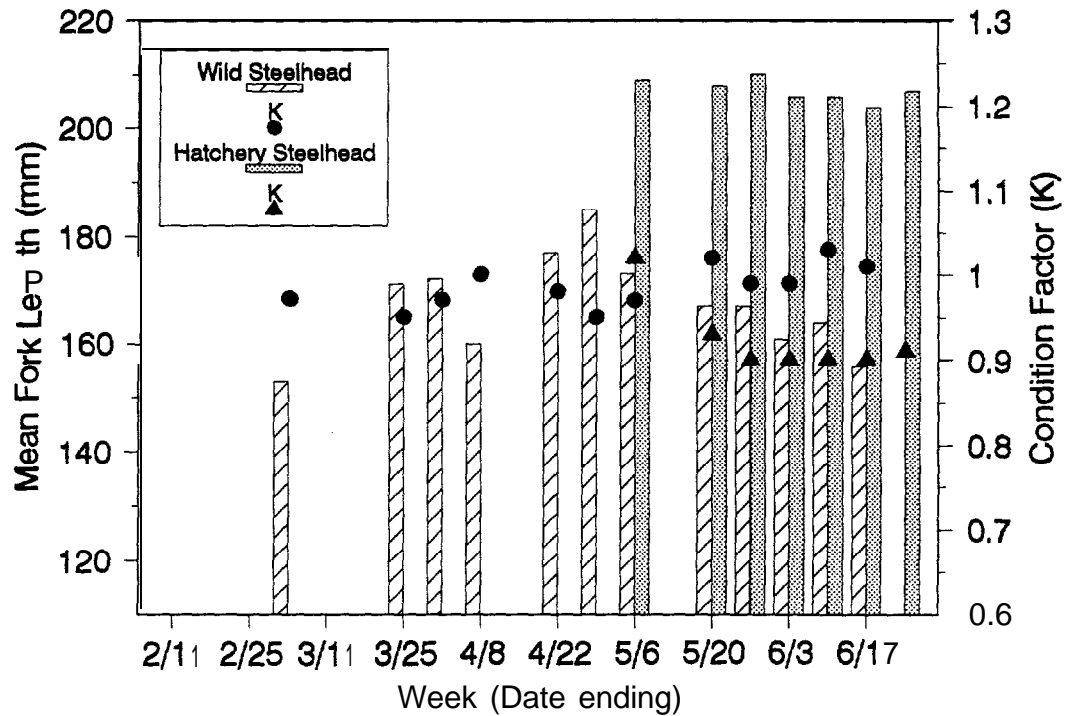


Figure 8. Weekly mean length and condition factor of wild and hatchery steelhead trout smolts trapped in the Imnaha River, February 6 - June 20, 1995.

Hatchery steelhead trout were about 35 mm larger than their wild counterparts, with a mean length of 208 mm, mean weight of 86.1 g, and mean condition factor (K) of 0.93 (Table 8). Weekly mean lengths of hatchery steelhead trout ranged from 204 to 210 mm (Figure 8). Condition factors of hatchery steelhead trout declined the third week after release in the Imnaha River, and remained at lower levels through mid-June. In comparison to wild steelhead trout, condition factors of hatchery fish were generally lower, ranging from 0.9 to 1.02 (Figure 8).

Daily sample size, mean and standard deviation for length, weight and condition factor details for wild and hatchery chinook salmon and steelhead trout smolts are contained in Appendix D.

Mortality

Mortality was tallied for each anadromous salmonid species of wild and hatchery origin to determine the effects of trapping, handling and tagging on the fish. Mortality rates were 0.78% for wild chinook salmon, 0.05% for hatchery chinook salmon (HxW), 1.67% for hatchery chinook salmon (HxH), 1.39% for wild steelhead trout, and 1.59% for hatchery steelhead trout smolts (Table 9). Trapping was the major cause of mortality for each group of fish (Table 9).

Table 9. Mortality of chinook salmon and steelhead trout smolts due to trapping and PIT tagging.

Number capture	Wild Chinook		Hatchery Chinook		Wild Steelhead		Hatchery Steelhead	
	2,430		H x W 63,976	H x H 10,902	789		7,237	
Mortality								
Source	n	%	n	%	n	%	n	%
Trapping	19	0.78	25	0.04	182	1.67	11	1.39
PIT tagging	0	0	4	<0.01	0	0	0	0
Total	19	0.78	29	0.05	182	1.67	11	1.39

Incidental Catch

Species incidentally captured during our investigation included: nine adult steelhead, twelve smallmouth bass (*Micropterus dolomieu*), three bull trout (*Salvelinus confluentus*), and four mountain whitefish (*Prosopium williamsoni*) (Table 10). Non-game fish captured included longnose dace (*Rhinichthys cataractae*), bridgelip sucker (*Catostomus columbianus*), chiselmouth (*Acrocheilus alutaceus*), reddsideshiner (*Richardsonius balteatus*), northern squawfish (*Ptychocheilus oregonensis*) and sculpin (*Cottus* sp.) (Table 10). Appendix E contains daily incidental catch data.

Outmigration of PIT Tagged Fish

Imnaha River Outmigration

ODFW released a total of 3,974 PIT tagged hatchery chinook salmon smolts from the Imnaha River acclimation ponds between March 28 and April 26, 1995. Of those released on March 28 (2,494), we captured 269 (10.8%) of these fish in our trap. The majority (74%) were interrogated on March 29, one day after release (Figure 9). Of those PIT tagged hatchery chinook salmon released on April 5 (493), April 24 (496), and April 26 (491), we captured 15 (3%), 28 (6%), and 8 (2%) of these fish, respectively. Of the 2,494 PIT tagged hatchery chinook salmon released by ODFW on March 28, a total of 1306 (52.4%) were interrogated at the mainstem Snake and Columbia River dams.

A total of 1,484 PIT tagged hatchery steelhead trout smolts were released by ODFW at the Little Sheep Creek acclimation pond on May 1, 1995. We interrogated 3 (0.2%) PIT tagged hatchery steelhead trout on May 2 and 2 (0.13%) on May 3. Due to

Table 10. Weekly catch composition of incidental fish species collected in the Imnaha River trap, February 6 – June 20, 1995.

Date	STHD	BT	MWF	SMB	SC	BLS	NSF	CHSL	LND	RSS	CATCH
Feb 5 – Feb 11	0	0	1	0	0	8	0	0	0	2	11
Feb 12 – Feb 18	0	0	0	0	0	0	0	0	0	0	0
Feb 19 – Feb 25	0	0	0	0	1	6	0	1	0	1	9
Feb 26 – Mar 4	0	1	2	0	0	0	0	0	0	0	3
Mar 10 – Mar 11	0	0	0	0	0	0	0	0	0	0	0
Mar 12 – Mar 18	0	0	0	0	0	0	0	cl	0	0	0
Mar 19 – Mar 25	0	0	0	0	2	0	0	0	0	0	2
Mar 26 – Apr 1	0	0	0	5	0	5	4	1	22	0	37
Apr 2 – Apr 8	0	0	0	1	1	11	0	1	2	0	16
Apr 9 – Apr 15	0	0	0	0	0	0	0	0	0	0	0
Apr 16 – Apr 22	1	0	0	1	3	1	0	0	0	0	6
Apr 23 – Apr 29	1	0	0	2	1	14	0	0	7	0	25
Apr 30 – May 6	1	0	0	3	0	0	1	0	0	1	6
May 7 – May 13	0	0	0	0	0	0	0	0	0	0	0
May 14 – May 20	1	0	0	0	1	1	0	0	0	0	3
May 21 – May 27	3	0	0	0	0	2	2	1	0	0	8
May 28 – Jun 3	1	0	0	0	0	5	0	0	0	0	6
Jun 4 – Jun 10	1	2	0	0	0	33	1	1	0	0	38
Jun 11 – Jun 17	0	0	1	0	0	20	1	0	0	0	22
Jun 18 – Jun 20	0	0	0	0	0	129	0	0	0	0	129
TOTAL	9	3	4	12	9	235	9	5	31	4	321

STHD Adult steelhead trout
 BT Bull trout
 MWF Mountain whitefish
 SMB Smallmouth bass
 SC Sculpin

BLS Bridgefip sucker
 NSF Northern squawfish
 CHSL Chiselmouth
 LND Longnose dace
 RSS Redside shiner

high stream discharge we were unable to effectively sample the hatchery steelhead smolt outmigration.

One wild chinook tagged by ODFW during the summer of 1994 was interrogated at the trap during the study period.

PIT Tag Release Groups

We PIT tagged and released 421 wild chinook salmon smolts at the Imnaha River screw trap during the spring emigration period. All PIT tagged wild chinook salmon smolts were held a minimum of 12 hours and released at dark (NPT investigations) (See Methods for details). Mean lengths of weekly release groups ranged from 100 to 105 mm, weights from 9.9 to 12.4 g, and condition factors from 0.97 to 1.13 (Table 11). Weekly release groups consisted of over 50 wild chinook salmon from April 8 to June 17, 1995, with three exceptions; weeks ending April 15, June 10, and June 17 (Table 11).

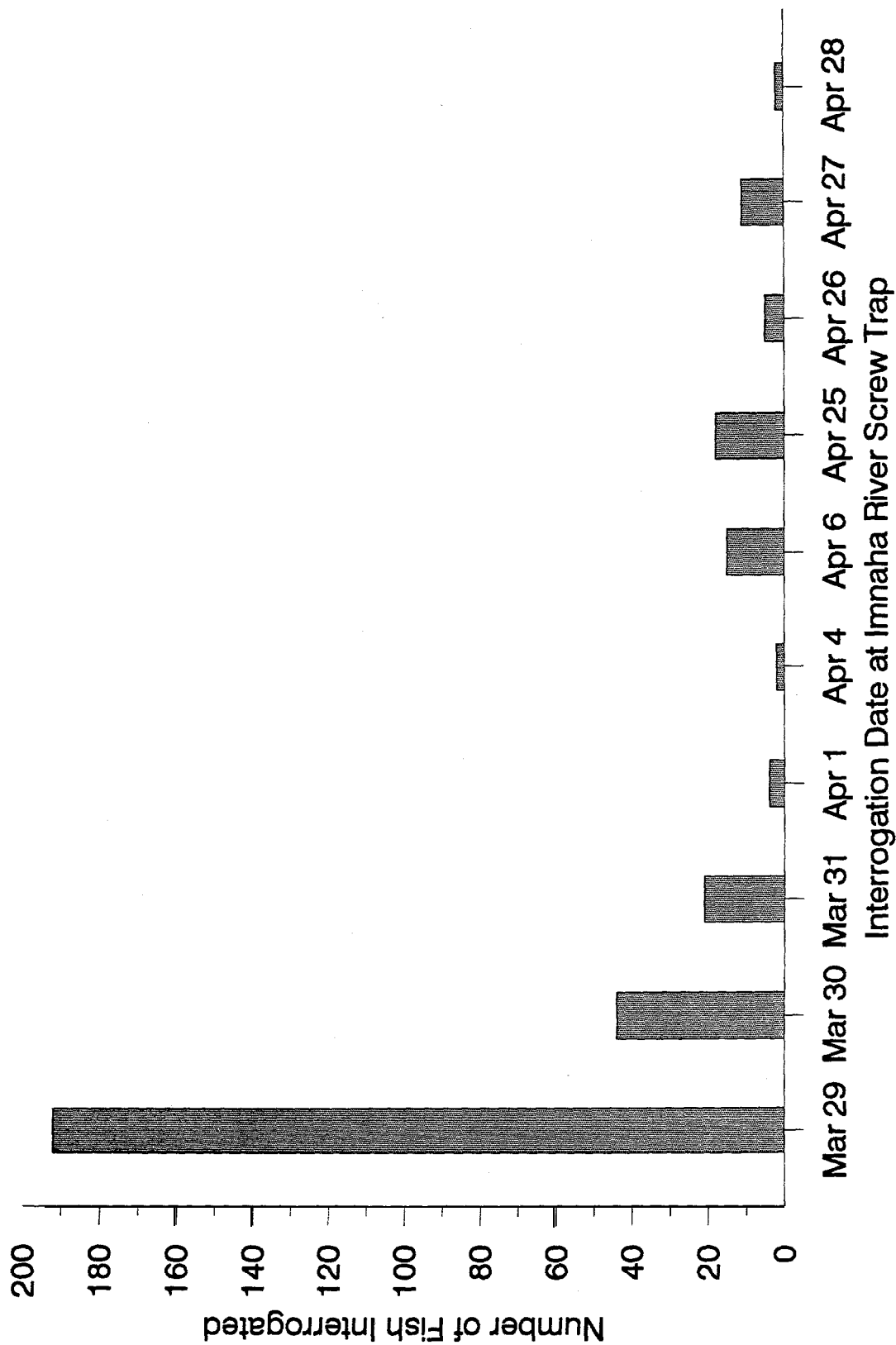


Figure 9. Outmigration timing of PIT tagged hatchery chinook salmon smolts released between March 28 - April 26, 1995 at the Imnaha River Acclimation Pond.

Table 11. Mean fork length (mm), weight (g), and condition factor for each weekly release group of NPT PIT tagged wild chinook salmon smolts released at the Imnaha River screw trap, March 10 – June 20, 1995.

Release Week Date Ending	n	Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)
Apr 8	84	102 (10.9)	10.3 (2.4)	0.97 (0.09)
Apr 15	26	100 (5.5)	9.9 (1.7)	1.00 (0.07)
Apr 22	136	101 (7.0)	11.3 (2.5)	1.07 (0.07)
Apr 29	148	105 (8.6)	12.4 (2.7)	1.08 (0.16)
Jun 10	20	101 (9.8)	11.2 (3.0)	1.07 (0.07)
Jun 17	7	103 (8.9)	12.4 (2.7)	1.13 (0.07)
TOTAL	421	102 (8.7)	11.4 (2.7)	1.05 (0.12)

We PIT tagged 747 hatchery chinook salmon smolts during the study period; 445 were hatchery x wild crosses which were held a minimum of 12 hours and released at dark (NPT investigations) and 302 were hatchery x hatchery crosses released approximately one hour after tagging (FPC investigations). Mean lengths of weekly release groups ranged from 120 to 127 mm, weights from 18.1 to 22.3 g, and condition factors from 1.02 to 1.09 (Table 12). Weekly release groups consisted of over 100 hatchery chinook salmon from April 8 to April 29, 1995, with one exception; week ending April 22 (Table 12).

We PIT tagged 227 wild steelhead trout smolts during the study period; all of which were released approximately one hour after tagging (FPC investigations). Mean lengths of weekly release groups ranged from 156 to 185 mm, weights from 39.1 to 61.6 g, and condition factors from 0.95 to 1.01 (Table 13).

We PIT tagged 1,296 hatchery steelhead trout smolts during the study period; all of which were released approximately one hour after tagging (FPC strategy). A substantial number of hatchery steelhead smolts appeared to be in poor general health due to loss of fish mucous coating and descaling. Mean lengths of weekly release

Table 12. Mean fork length (mm), weight (g), and condition factor for each weekly release group of PIT tagged hatchery chinook salmon **smolts** released at the Imnaha River screw trap, March 10 – June 20, 1995. NPT=held 12 hours and released at dark, FPC =**released** after recovery from tagging, (approximately one hour).

Hatchery Chinook Salmon									
Release Date	Week Ending	n	NPT Investigations			n	FPC Investigations		
			Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)		Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)
Apr 8		184	124 (7.8)	20.8 (4.3)	1.07 (0.08)	100	127 (7.9)	22.3 (4.5)	1.09 (0.08)
Apr 22		37	123 (9.2)	19.8 (4.9)	1.04 (0.06)	9	120 (4.6)	18.1 (1.8)	1.05 (0.06)
Apr 29		224	125 (7.0)	20.6 (3.4)	1.06 (0.06)	193	127 (7.9)	20.9 (4.2)	1.02 (0.10)
TOTAL		445	124 (7.6)	20.6 (3.9)	1.06 (0.07)	302	126 (7.9)	21.3 (4.3)	1.04 (0.10)

Table 13. Mean fork length (mm), weight (g), and condition factor for each weekly release group of PIT tagged wild steelhead trout smolts released at the Imnaha River screw trap, March 10 – June 20, 1995.

Release Date	Week Ending	n	Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)
Apr 29		137	185 (18.0)	61.6 (20.3)	0.95 (0.06)
May 6		84	174 (17.0)	52.7 (16.7)	0.97 (0.07)
Jun 17		6	156 (10.3)	39.1 (7.3)	1.01 (0.04)
TOTAL		227	180 (18.6)	57.7 (19.5)	0.96 (0.06)

groups ranged from 205 to 213 mm, weights from 79.6 to 95.8 g, and condition factors from 0.89 to 1.02 (Table 14).

Table 14. Mean fork length (mm), weight (g), and condition factor for each weekly release group of PIT tagged hatchery steelhead trout smolts released at the Imnaha River screw trap, March 10 – June 20, 1995.

Release Week Date Ending	n	NPT Investigations			n	FPC Investigations		
		Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)		Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)
May 6	150	209 (15.7)	95.8 (23.0)	1.02 (0.06)	197	209 (15.6)	94.1 (22.7)	1.01 (0.06)
May 20					199	208 (18.9)	86.1 (25.2)	0.93 (0.07)
May 27	150	213 (19.7)	89.1 (29.1)	0.89 (0.06)				
Jun 3					201	206 (18.4)	79.7 (22.9)	0.90 (0.07)
Jun 10					122	206 (16.3)	79.6 (20.4)	0.90 (0.05)
Jun 17					77	205 (21.7)	81.8 (30.7)	0.92 (0.06)
TOTAL	300	211 (17.9)	92.4 (26.4)	0.96 (0.09)	996	207 (18.1)	84.4 (24.6)	0.93 (0.08)

Snake River Flows

Stream discharge during the spring smolt outmigration period, measured at the Anatone gauge station (Figure 10), ranged from 27.7 to 47.0 kcfs from February 1 to late April. Beginning May 1, discharge increased steadily to June 5, peaking at 118.0 kcfs. Flows generally declined after June 15 but remained above 86.5 kcfs throughout the remainder of the study period.

Stream discharge measured at Lower Granite Dam (LGR) ranged from 36.1 to 84.1 kcfs from February 1 to late April (Figure 10). Discharge at LGR, paralleled increases in Snake River flows observed at the Anatone gauge station, steadily increasing from May 1 to June 6, peaking at 148.9 kcfs. Flows generally declined after June 6 but remained at or above 102.1 kcfs through the remainder of the study period.

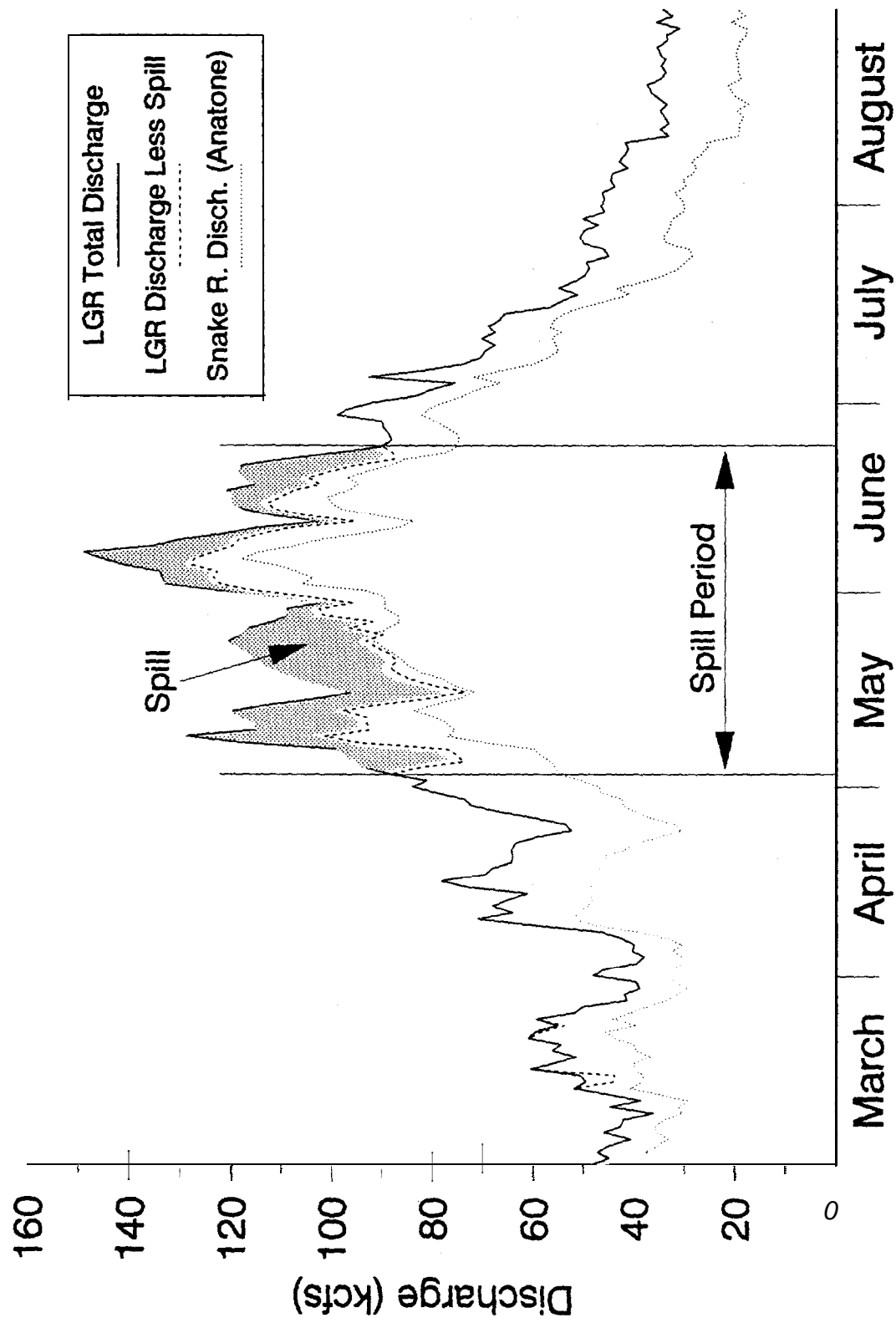


Figure 10. Total water discharge at Lower Granite Dam (LGR), water spill period at LGR and Snake River discharge at the Anatone gauge station, March - August, 1995.

The water spill period at LGR was initiated on May 3 and occurred continuously through June 22, when spill ended. Water spill ranged from 6.28 kcfs on May 27 to 27.43 kcfs on May 8. Water spill occurred on several occasions (March 14-15, March 22-23) prior to the initiation of continuous spill on May 3.

Interrogation Rates

Interrogation rates were based on first observation detections at the mainstem Snake River (Lower Granite, Little Goose and Lower Monumental dams) and Columbia River (McNary Dam) dams.

A total of 330 (78.4%) of the 421 PIT tagged wild chinook salmon smolts released at the Imnaha River trap were interrogated (or detected) at mainstem dams (Table 15). Cumulative interrogation rates for weekly release groups ranged from 74.3% to 83.1%, all for fish tagged in mid to late April (Figure 11). The April 15, June 10, and June 17 release groups contained less than 30 PIT tagged wild chinook which did not provide a sufficient sample sizes to base analysis on.

Table 15. Interrogation rates (based on first observations) of weekly release groups of NPT PIT tagged wild chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams.

Release Week	Number	Granite		Goose		LoMo		McNary		Total	
Date Ending	Tagged	n	%	n	%	n	%	n	%	n	%
Apr 8	84	47	56.0	8	9.5	4	4.8	5	6.0	64	76.2
Apr 15	26	11	42.3	5	19.2	5	19.2	1	3.8	22	84.6
Apr 22	136	65	47.8	29	21.3	12	8.8	7	5.1	113	83.1
Apr 29	148	53	35.8	31	20.9	20	13.5	6	4.1	110	74.3
Jun 10	20	6	30.0	8	40.0	2	10.0	1	5.0	17	85.0
Jun 17	7	3	42.8	0		1	14.3	0		4	57.1
TOTAL	421	185	43.9	81	19.2	44	10.5	20	4.8	330	78.4

Of the 747 PIT tagged hatchery chinook salmon smolts released at the Imnaha River trap 262 (58.9%) of the 445 NPT fish (HxW crossed) were interrogated, compared to 171 (56.6%) of the 302 FPC fish (HxH crossed) (Tables 16 and 17). Cumulative interrogation rates for weekly release groups were generally similar for both release strategies, ranging from 55.8 to 67.6% and 52.3 to 68.0% for NPT and FPC fish, respectively (Figures 12 and 13). Only 22.2% of the April 22 release group (FPC) were interrogated which could be due, in part, to the small sample size (Table 17).

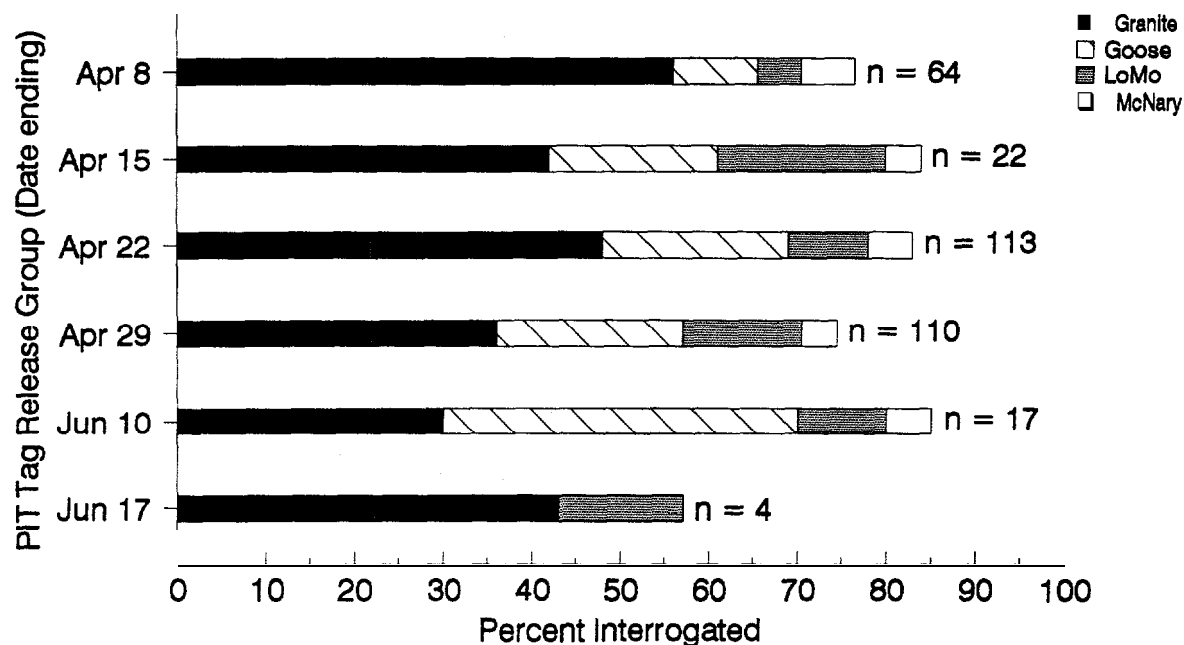


Figure 11. Cumulative interrogations, by weekly PIT tag release group, of NPT tagged wild chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental, and McNary Dams, April 11 - August 4, 1995.

A total of 173 (76.2%) of the 227 PIT tagged wild steelhead trout smolts released at the Imnaha River trap were interrogated at mainstem dams (Table 18). Cumulative interrogation rates of weekly release groups ranged from 65.5% for the May 6 release group to 83.2% for the April 29 release group (Figure 14). The June 17 release group contained only six PIT tagged fish and could not be used for analysis (Table 18).

Of the 1,296 PIT tagged hatchery steelhead trout smolts released at the Imnaha River trap 897 (69.2%) were interrogated (Table 19). Weekly cumulative interrogation rates for hatchery steelhead trout ranged from 61.7% for the June 3 release group to 79.2% for the June 17 release group (Figure 15).

Arrival Timing

PIT tagged Imnaha River wild chinook salmon smolts arrived at Lower Granite Dam from April 11 to July 11 with median and 90% passage dates of May 1 and May 11 respectively (Table 20). The 90% passage date for wild chinook at LGR (May 11) preceded peak Snake River and LGR flows (June 5) by 26 days. Wild chinook smolts passed Little Goose Dam between April 15 and July 15. The median passage date at Little Goose Dam was May 7 and 90% of wild chinook smolt passage occurred by May 20. Wild chinook smolt movement past Lower Monumental Dam and McNary Dams occurred between April 19 to August 4 and April 28 to July 9, respectively (Figure 16).

Table 16. Interrogation rates (based on first observations) of weekly release groups of NPT PIT tagged HxW crossed hatchery chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 8	184	59	32.1	34	18.5	13	7.1	6	3.3	112	60.9
Apr 22	37	18	48.6	6	16.2	1	2.7	0		25	67.6
Apr 29	224	53	23.7	44	19.6	19	8.5	9	4.0	125	55.8
TOTAL	445	130	29.2	84	18.9	33	7.4	15	3.4	262	68.9

Table 17. Interrogation rates (based on first observations) of weekly release groups of FPC PIT tagged HxH crossed hatchery chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 8	100	38	38.0	21	21.0	5	5.0	4	4.0	68	68.0
Apr 22	9	1	11.1	1	11.1	0		0		2	22.2
Apr 29	193	46	23.8	22	11.4	26	13.5	7	3.6	101	52.3
TOTAL	302	85	28.1	44	14.6	31	10.3	11	3.6	171	56.6

Table 18. Interrogation rates (based on first observations) of weekly release groups of FPC PIT tagged wild steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 29	137	91	66.4	14	10.2	8	5.8	1	0.7	114	83.2
May 6	84	34	40.5	12	14.3	9	10.7	0		55	65.5
Jun 17	6	2	33.3	2	33.3	0		0		4	66.7
TOTAL	227	127	55.9	28	12.3	17	7.5	1	0.4	173	76.2

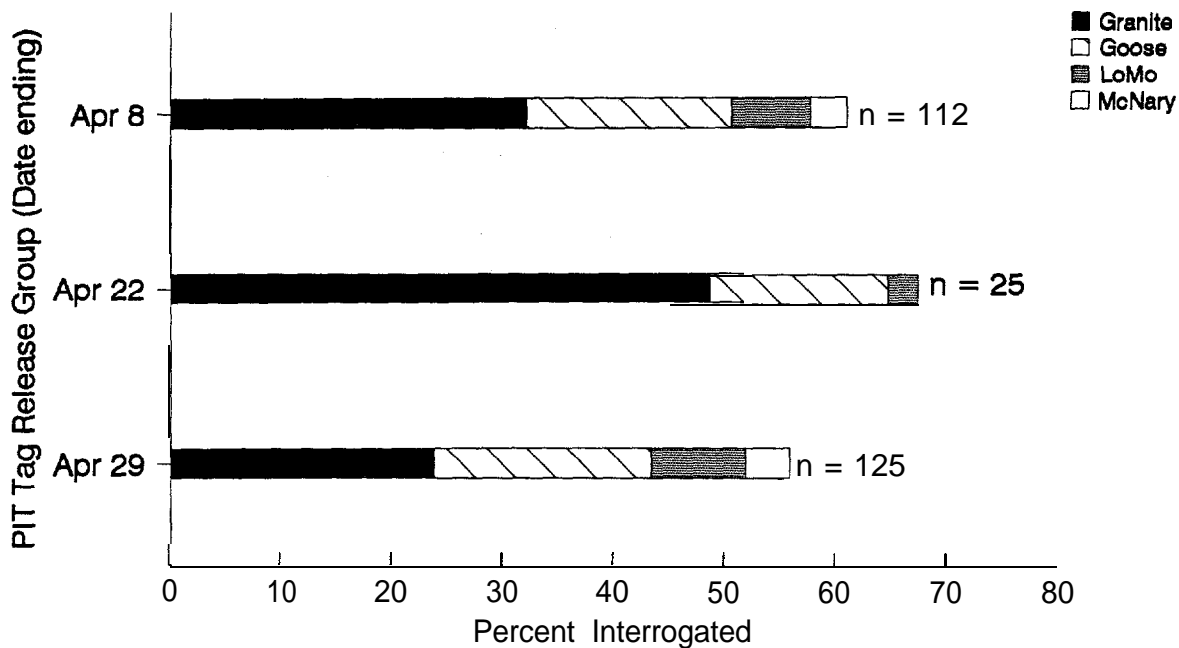


Figure 12. Cumulative interrogations, by weekly PIT tag release group, of NPT tagged HxW crossed hatchery chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental, and McNary Dams, April 13 - June 7, 1995.

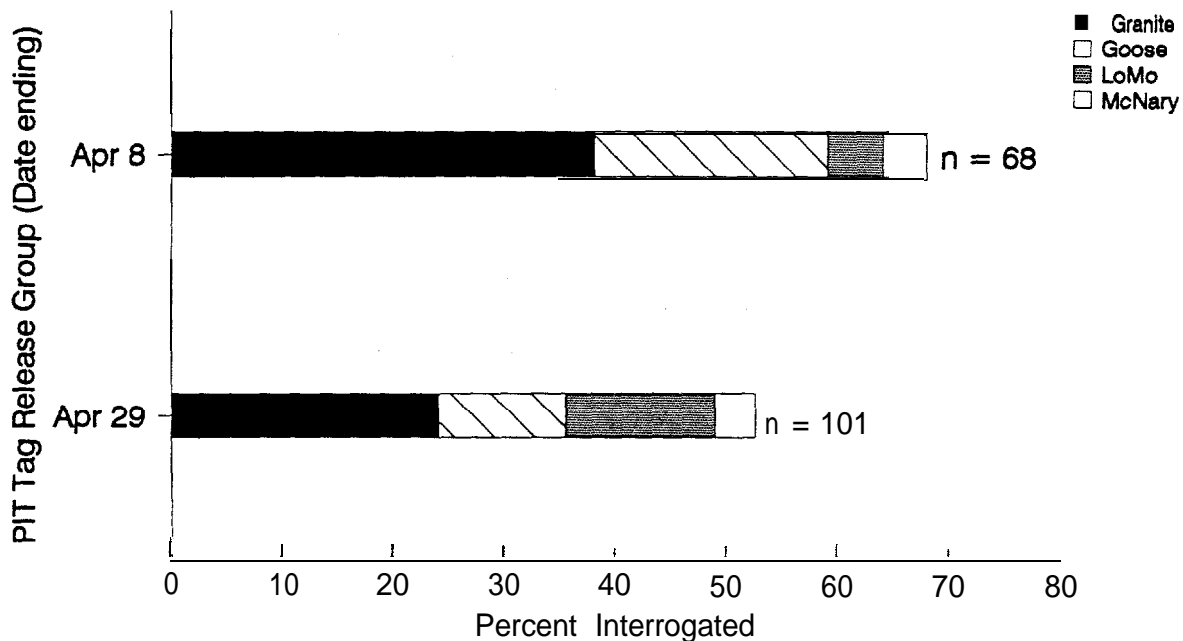


Figure 13. Cumulative interrogations, by weekly PIT tag release group, of FPC tagged HxH crossed hatchery chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental, and McNary Dams, April 16 - May 27, 1995.

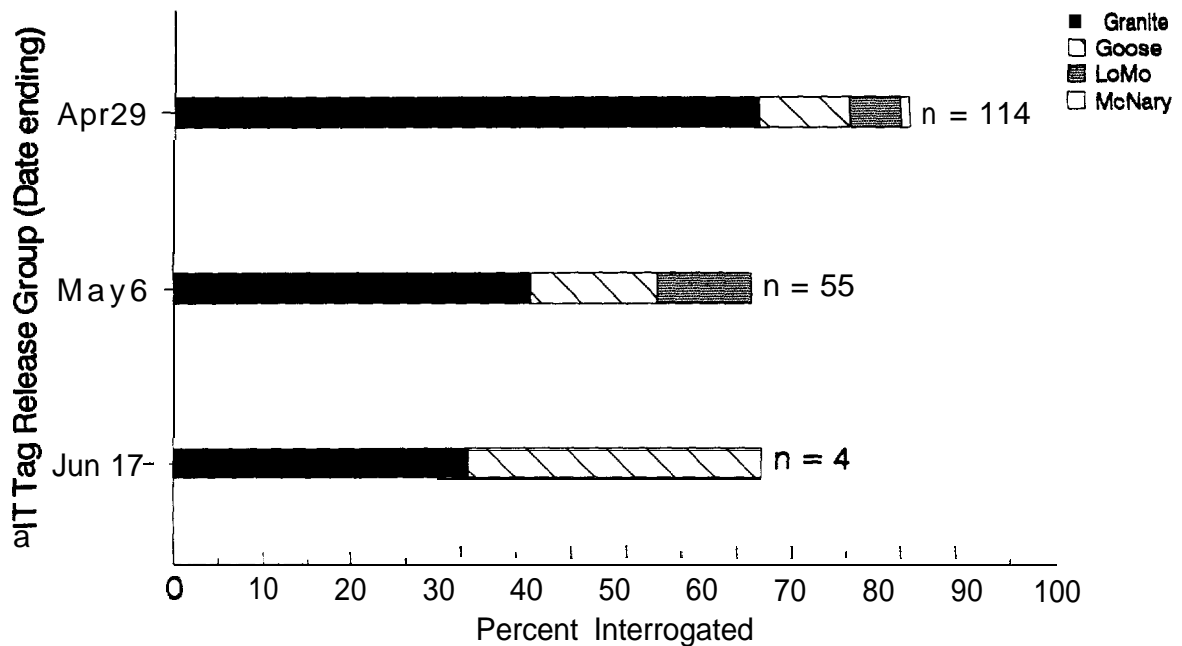


Figure 14. Cumulative interrogations, by weekly PIT tag release group, of FPC tagged wild steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental, and McNary Dams, April 28 - June 20, 1995.

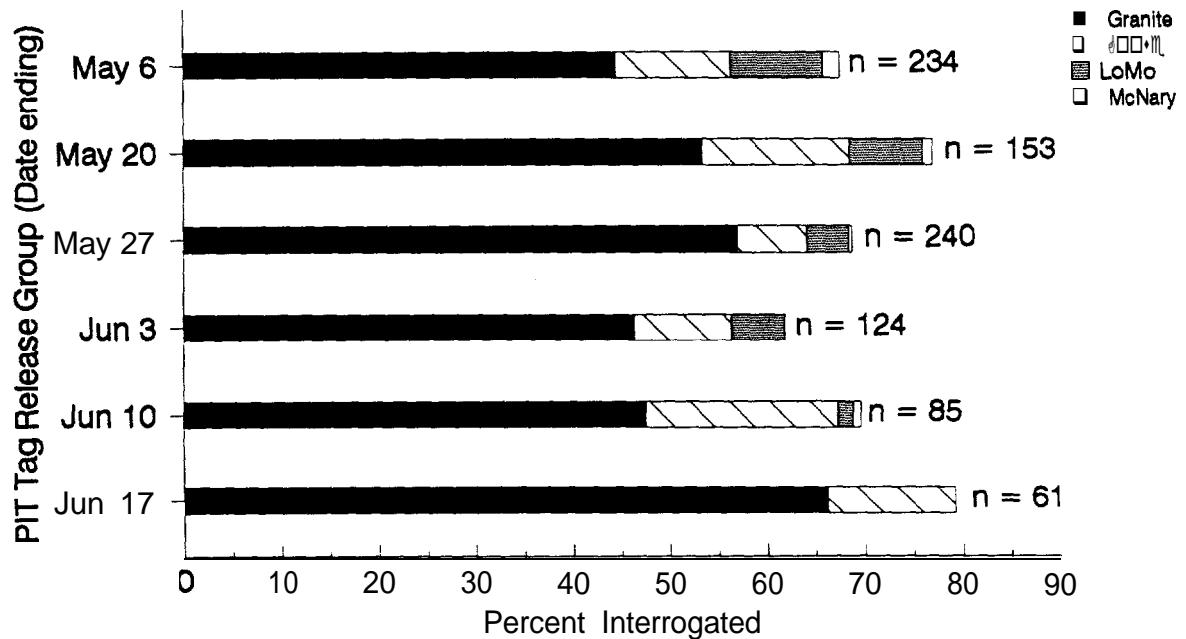


Figure 15. Cumulative interrogations, by weekly PIT tag release group, of NPT and FPC tagged hatchery steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental, and McNary Dams, May 6 - July 13, 1995.

Table 19. Interrogation rates (based on first observations) of weekly release groups of NPT and FPC PIT tagged hatchery steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams.

Release Week Date Ending	Number	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
May 6	347	154	44.4	41	11.8	33	9.5	6	1.7	234	67.4
May 20	199	106	53.3	30	15.1	15	7.5	2	1.0	153	76.9
May 27	350	199	56.9	25	7.1	15	4.3	1	0.3	240	68.6
Jun 3	201	93	46.3	20	10.0	11	5.5	0		124	61.7
Jun 10	122	58	47.5	24	19.7	2	1.6	1	0.8	85	69.7
Jun 17	77	51	66.2	10	13.0	0		0		61	79.2
TOTAL	1296	661	51.0	150	11.6	76	5.9	10	0.8	897	69.2

Peaks in arrival occurred in early to mid-May at Lower Granite, Little Goose, and Lower Monumental Dams (Figure 16).

Arrival of PIT tagged Imnaha River hatchery chinook salmon smolts ranged from April 13 to June 7 at Lower Granite Dam, April 26 to June 11 at Little Goose Dam, April 27 to June 10 at Lower Monumental Dam and April 29 to June 9 at McNary Dam. Median and 90% arrival dates of NPT tagged fish at Lower Granite and Little Goose occurred on May 2 and May 13, and May 10 and May 20, respectively (Table 20). Arrival timing of FPC tagged hatchery chinook salmon followed the same general trend as the NPT fish but had median and 90% arrival dates of up to six days later (Figure 17). Peak arrival of NPT tagged fish at Lower Granite Dam occurred in early May. Arrival of hatchery chinook salmon tagged by FPC followed a bimodal distribution, arriving in early and mid-May (Figure 17).

Wild steelhead trout smolts from the Imnaha River arrived at Lower Granite Dam from April 28 to June 19, at Little Goose Dam from May 1 to June 23, at Lower Monumental Dam from May 3 to May 17, and at McNary Dam from May 5 to May 27 (Table 20). Median and 90% arrival dates of wild steelhead trout at LGR occurred on May 2 and May 9, respectively (Table 20). Peak arrival of wild steelhead trout smolts at LGR occurred during early May (Figure 18) and mid-May at Lower Monumental Dam (Figure 19).

Imnaha River hatchery steelhead trout smolts arrived at Lower Granite Dam from May 6 to July 12, at Little Goose Dam from May 8 to July 13, at Lower Monumental Dam from May 9 to July 13 and at McNary Dam from May 15 to July 17. Median passage for PIT tagged hatchery steelhead trout smolts at LGR was on May 31 and

Table 20. First, median and 90% observation dates of PIT tagged Imnaha River wild and hatchery chinook salmon and steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental and McNary Dams from April through August, 1995.

Species/ Run Type	Release Group	Lower Granite Observation Date			Little Goose Observation Date			Lower Monumental Observation Date			McNary Observation Date		
		First	Median	90%	First	Median	90%	First	Median	90%	First	Median	90%
Chinook-W	NPT	Apr 11	May 1	May 11	Apr 15	May 7	May 20	Apr 19	May 8	Jun 4	Apr 28	May 12 ^a	May 21 ^a
Chinook-(HxW)	NPT	Apr 13	May 2	May 13	Apr 26	May 10	May 20	Apr 27	May 12	May 21	Apr 29	May 16 ^a	May 23 ^a
Chinook-(HxH)	FPC	Apr 16	May 8 ^a	May 15 ^a	Apr 27	May 12 ^a	May 23 ^a	Apr 29	May 17 ^a	May 26 ^a	May 3	May 16 ^a	May 22 ^a
Steelhead-W	FPC	Apr 28	May 2	May 9	May 1	May 7 ^a	May 12 ^a	May 3	May 9 ^a	May 14 ^a	May 5	May 11 ^a	May 17 ^a
Steelhead-H	BOTH	May 6	May 31	Jun 16	May 8	Jun 3	Jun 20	May 9	Jun 6	Jun 16	May 15	Jun 5 ^a	Jun 27 ^a

^aDate based on <1 detections and therefore may not provide meaningful passage information.

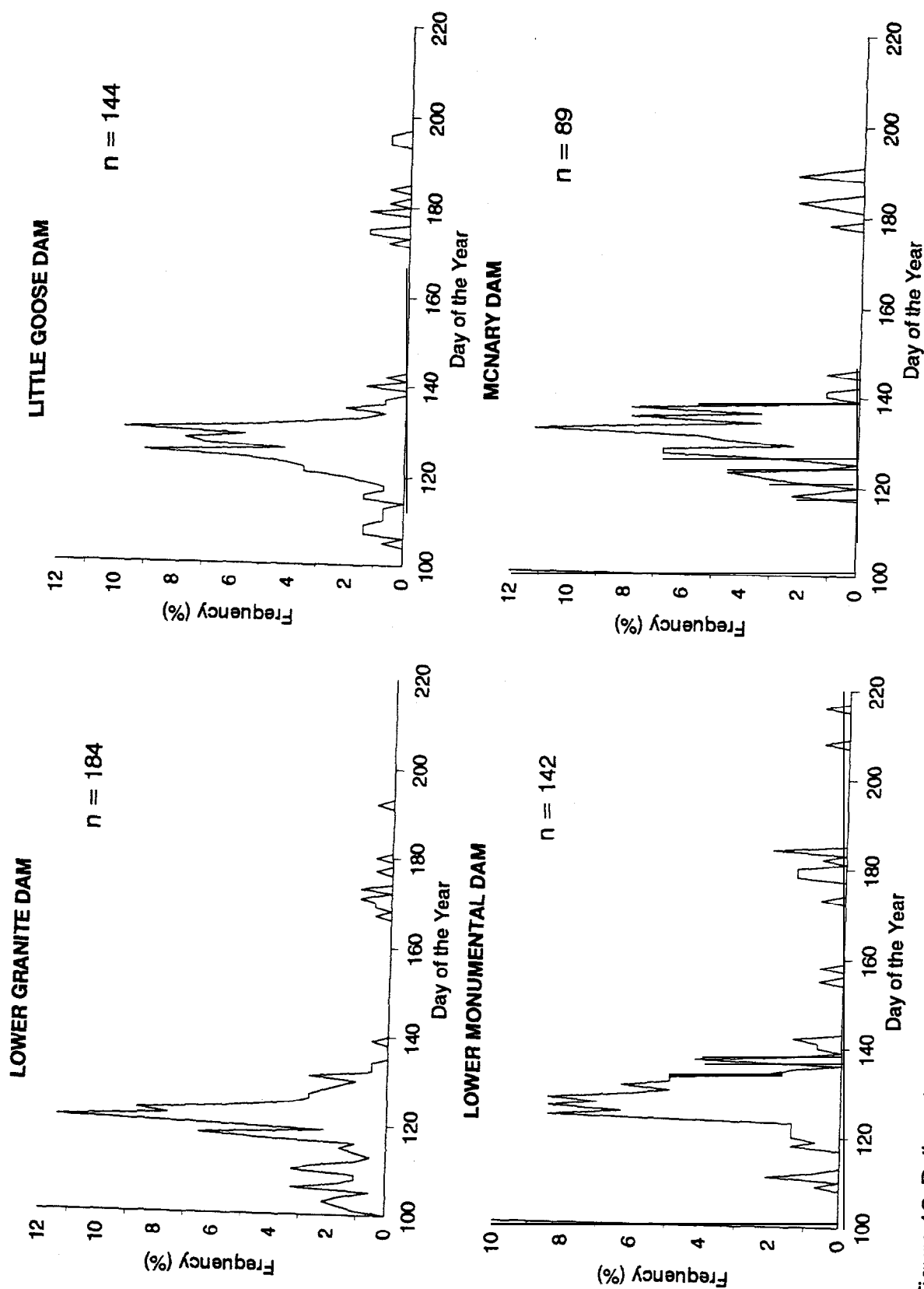


Figure 16. Daily arrival timing frequency of NPT PIT tagged Imnaha River wild chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental and McNary Dams, April 11 - August 4, 1995.

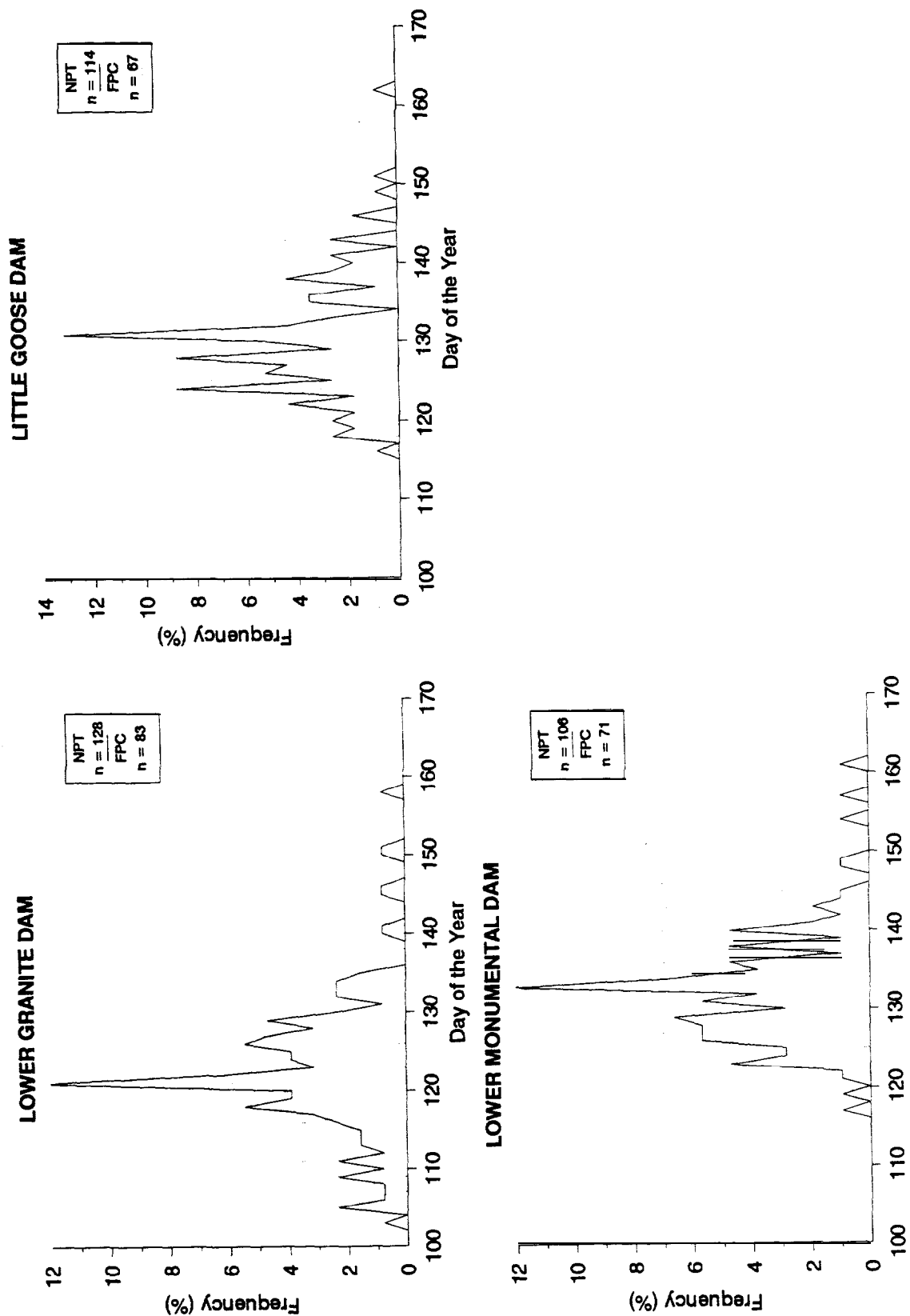


Figure 17. Daily arrival timing frequency of NPT (HxW crossed) and FPC (HxH crossed) PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Granite Dam, Little Goose Dam and Lower Monumental dam, April 13 - June 11, 1995.

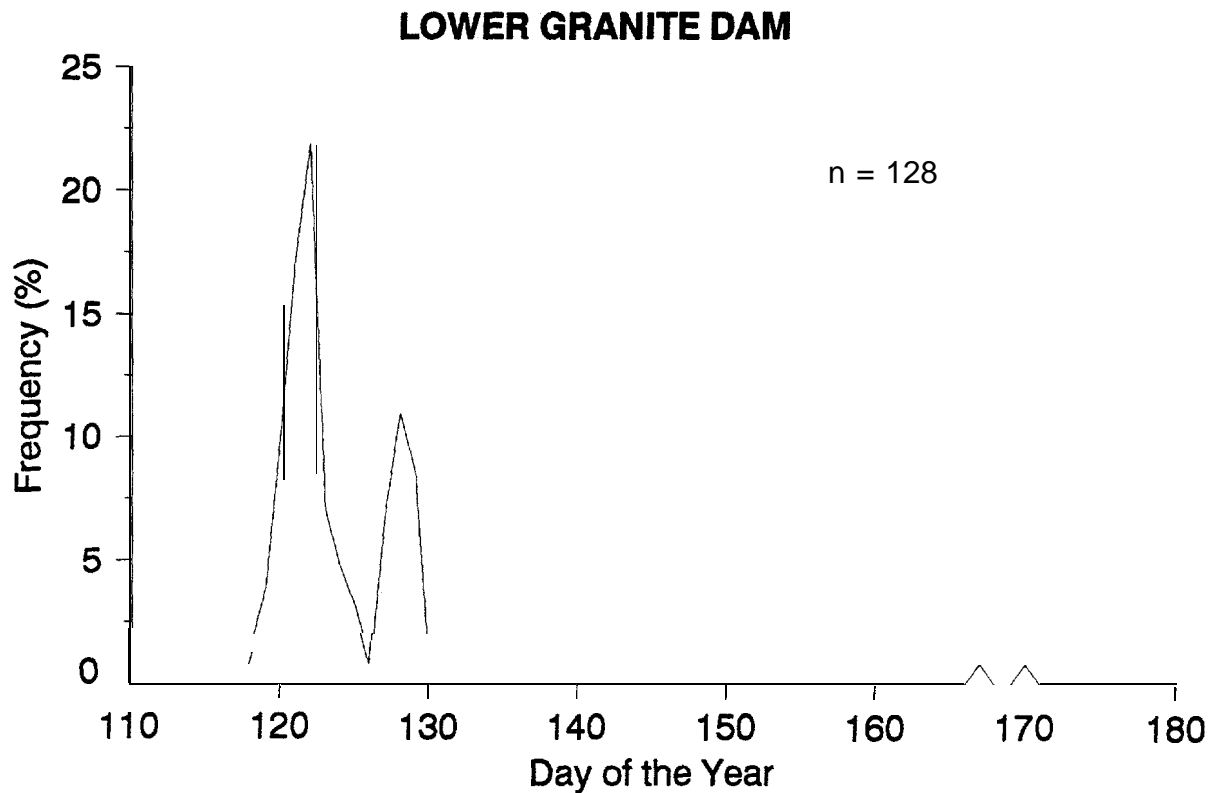


Figure 18. Daily arrival timing frequency of FPC PIT tagged Imnaha River wild steelhead trout smolts at Lower Granite Dam, April 28 - June 19, 1995.

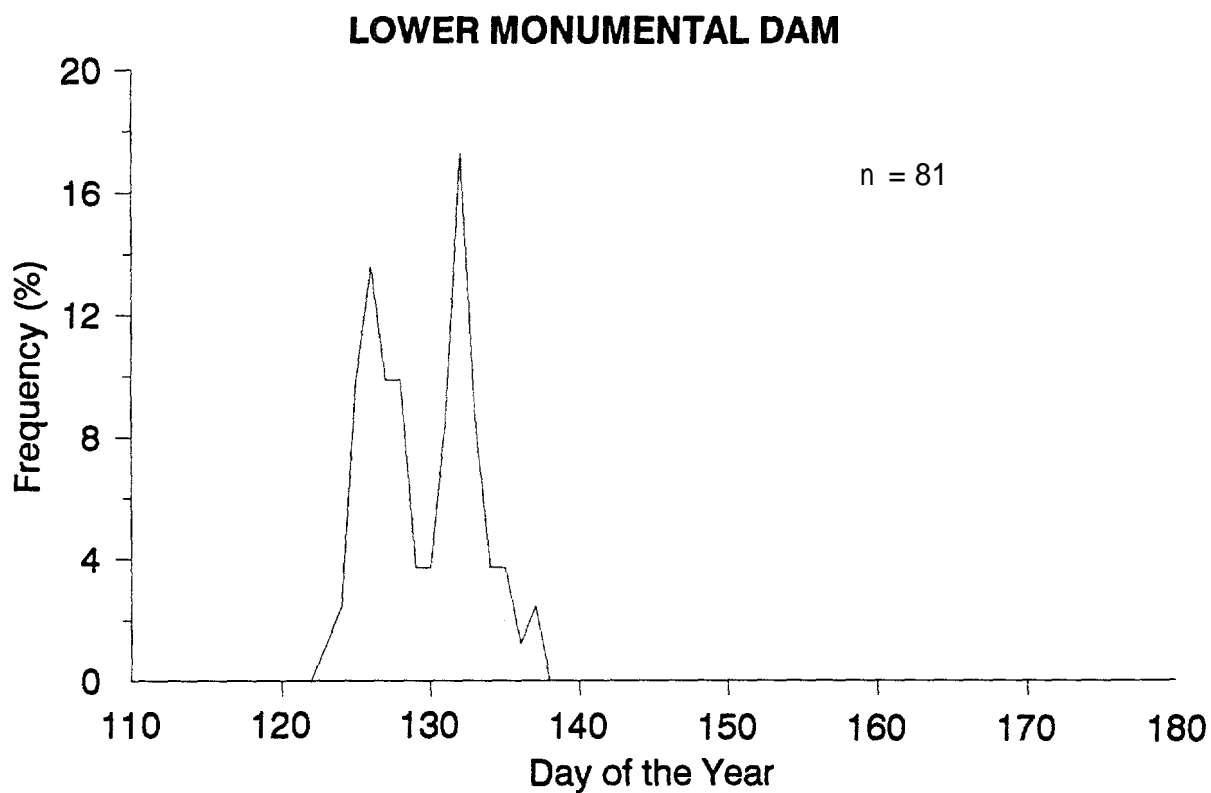


Figure 19. Daily arrival timing frequency of FPC PIT tagged Imnaha River wild steelhead trout smolts at Lower Monumental Dam, May 3 - May 17, 1995.

90% passage occurred on June 16 (Table 20). Median and 90% passage times for hatchery steelhead trout smolts at Little Goose Dam occurred on June 3 and June 20, respectively. Median and 90% passage dates for hatchery steelhead trout smolts at Lower Monumental Dam were June 6 and June 16 (Table 20). Although small peaks in arrival were observed, the general trend at each dam was a long protracted emigration (Figure 20).

Travel Time to Lower Granite Dam

Mean travel time of PIT tagged wild chinook salmon smolts from the Imnaha River screw trap (IMTRP) to Lower Granite Dam (LGR) ranged from 15 d for fish tagged in early April to 8.4 d for fish tagged in late April. Mean travel time was less for wild chinook salmon compared to hatchery chinook salmon (HxW) PIT tagged and released at the same time (Figure 21). Mean travel time for wild chinook salmon smolts generally decreased over the four continuous weeks that tagging occurred. PIT tag release groups of June 10 and June 17 had too few dam interrogations (6 and 3 respectively) to base sound travel time estimates on.

Hatchery chinook salmon smolts PIT tagged under NPT investigations were hatchery x wild crosses which were coded-wire-tagged (CWT) and had the adipose fin removed. Hatchery chinook salmon smolts PIT tagged under FPC investigations were hatchery x hatchery crosses that were coded-wire-tagged with ventral fin clips. Mean travel time of PIT tagged hatchery chinook salmon held for 12 hours and released at dark (NPT investigations) ranged from 12.7 d for the April 22 weekly release group to 21.5 d for those fish released during the week of April 8 (Figure 22). By comparison, mean travel time of PIT tagged hatchery chinook salmon released approximately one hour after tagging (FPC investigations) slightly decreased over time and was similar to the NPT fish released during the same periods.

Wild steelhead trout smolts were PIT tagged and released during three weeks of the study period. Mean travel time from the IMTRP to LGR ranged from 4.7 d for the tag group released in early May to 5.6 d for the group released in late April (Figure 23). The June 17 PIT tag release group contained only six smolts which precluded further travel time analysis.

Hatchery steelhead trout smolts were PIT tagged during six weeks of the study period. Mean travel time from the IMTRP to LGR ranged from 6 d for fish tagged in early June to 9.5 d for fish tagged in mid-June (Figure 23). Mean travel time to LGR for weekly released PIT tag groups decreased from May 6 through June 3 but then increased to 9.5 d on the week of June 10. Measured travel time decreased on the week of June 17 back down to 6.2 d similar to the results of the week of June 3.

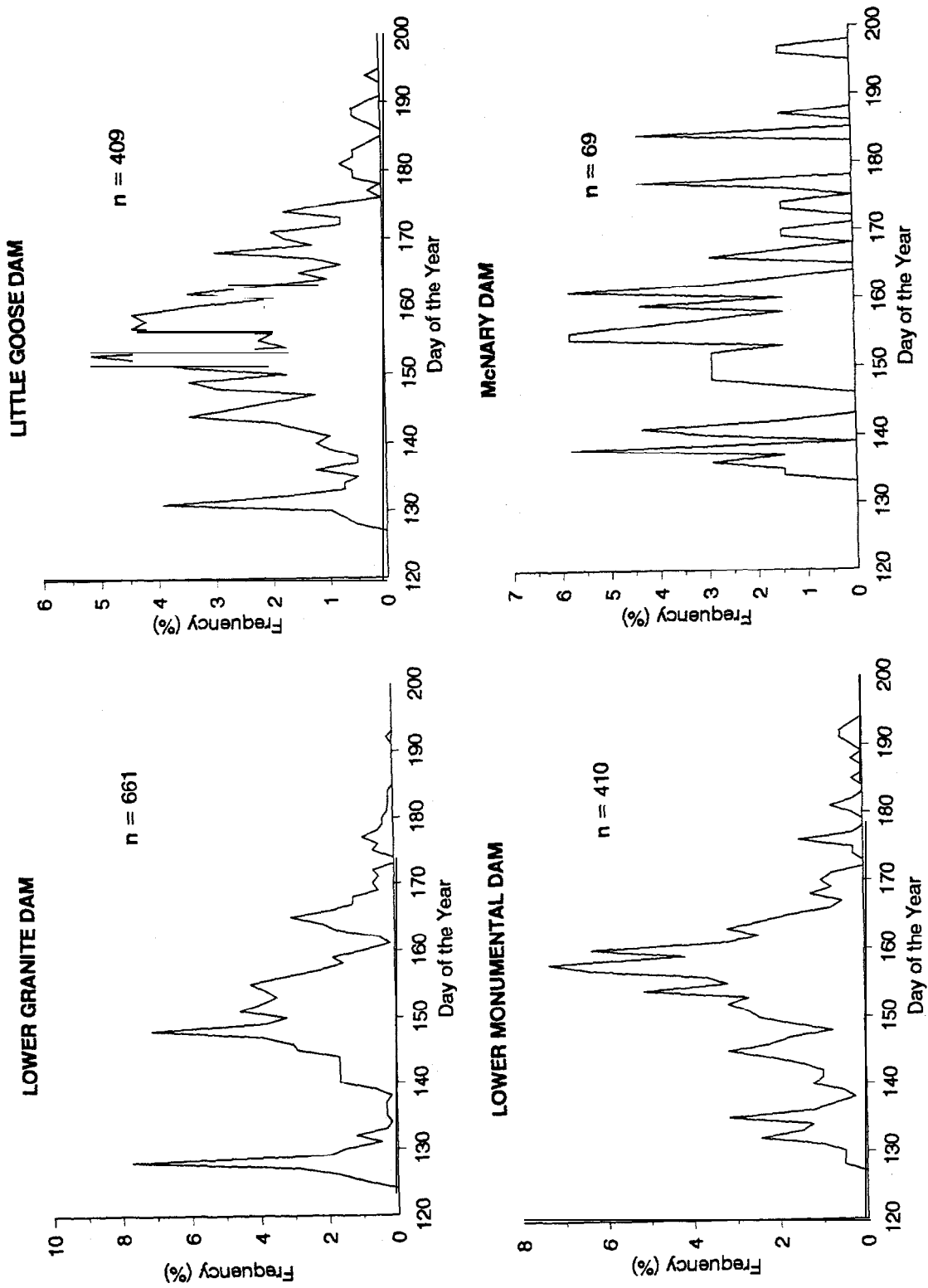


Figure 20. Daily arrival timing frequency of NPT and FPC PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 6 - July 17, 1995.

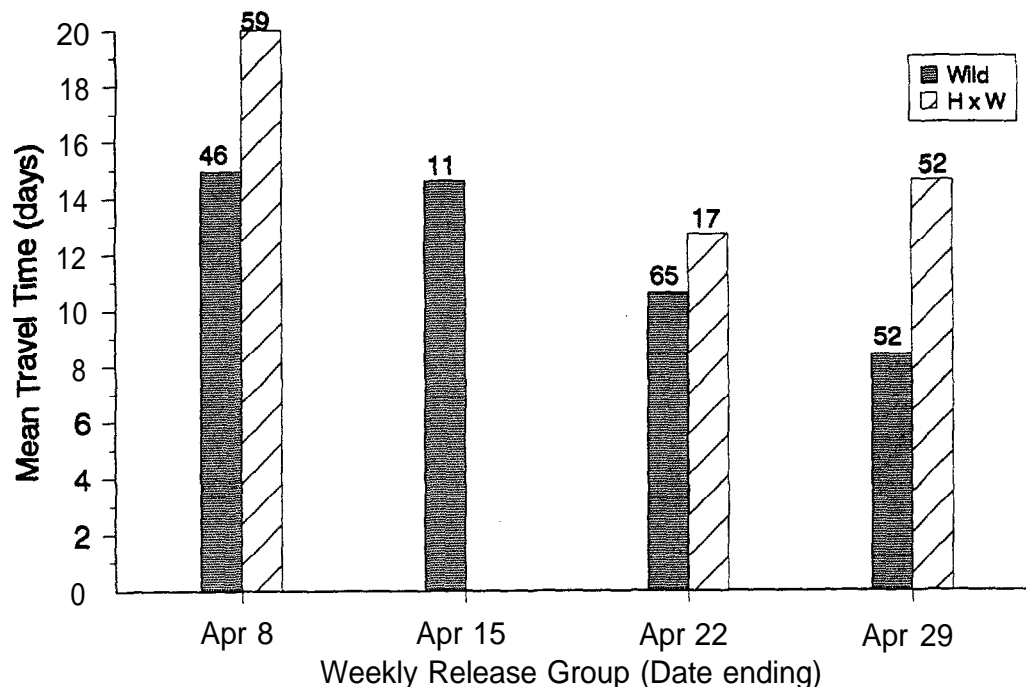


Figure 21. Mean travel time, by weekly PIT tag release group, of NPT tagged wild and hatchery (HxW crossed) chinook salmon smolts from the Imnaha River to Lower Granite Dam, April 5 - July 11, 1995.

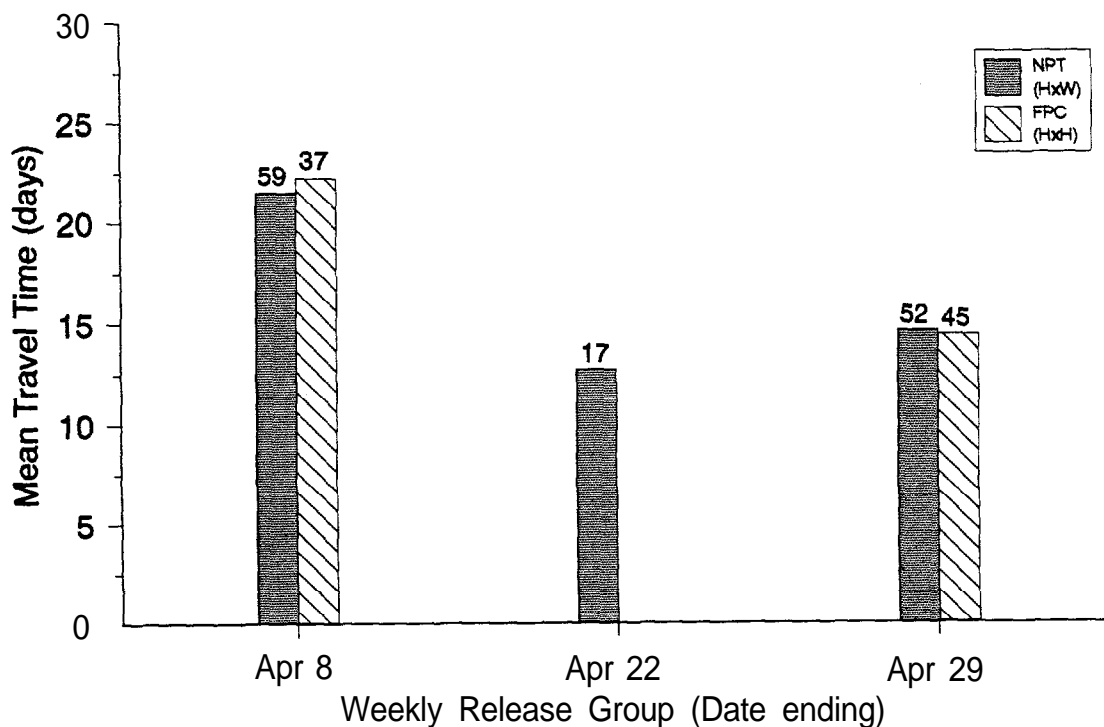


Figure 22. Mean travel time, by weekly PIT tag release group, of NPT (HxW crossed) and FPC (HxH crossed) tagged hatchery chinook salmon smolts from the Imnaha River to Lower Granite Dam, April 5 - June 7, 1995.

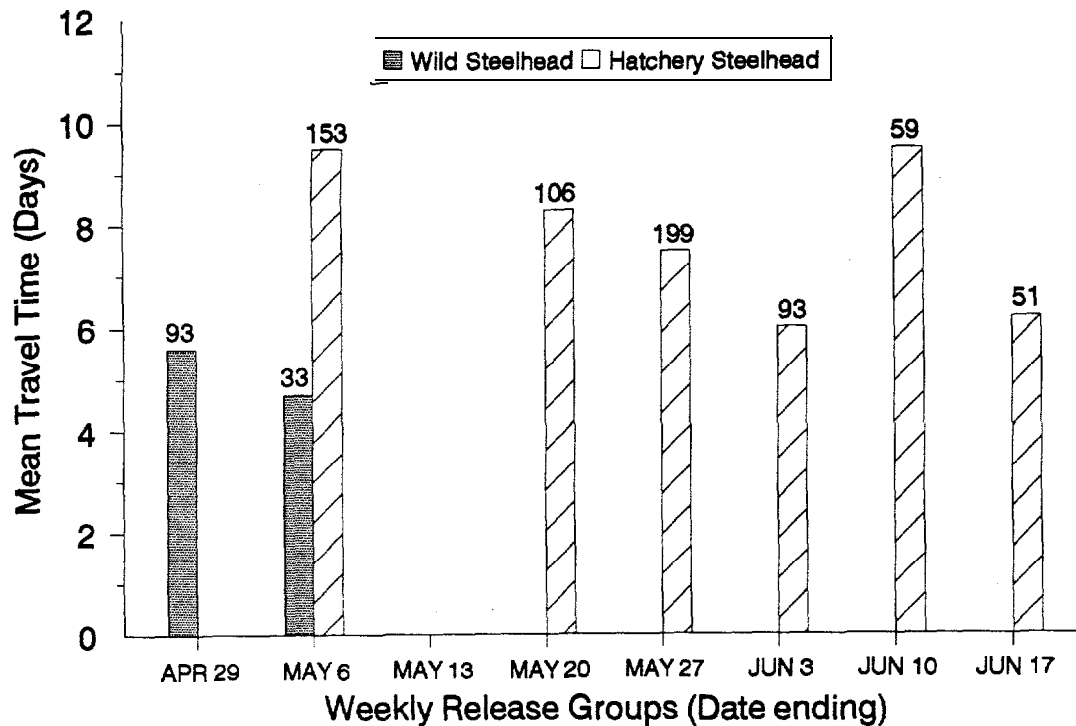


Figure 23. Mean travel time, by weekly PIT tag release group, of wild and hatchery steelhead trout smolts from the Imnaha River to Lower Granite Dam, April 24 - July 12, 1995.

SUMMARY

For the second consecutive year, the Nez Perce Tribe, in conjunction with the Fish Passage Center, participated in the smolt monitoring program in the Imnaha River. The Nez Perce Tribe's continuing efforts were aimed at providing the Fish Passage Center with information regarding smolt outmigration from the Imnaha River. A rotary screw trap was used to capture outmigrating wild and hatchery chinook salmon and steelhead trout smolts from February 6 to June 20, 1995.

A total of 2,430 wild chinook salmon, 63,976 hatchery chinook salmon (HxW), 10,902 hatchery chinook salmon (HxH), 47 (HxH) chinook salmon released as parr in 1994, 789 wild steelhead trout and 7,237 hatchery steelhead trout smolts were captured during the study. Wild chinook smolts averaged 99 mm in fork length, 10.7 g in weight and the mean condition factor was 1.07. No discernable trends in wild chinook salmon smolt size over time was observed during the outmigration period. Hatchery chinook salmon smolts (HxW) were notably larger than their wild counterparts having a mean length of 119 mm, mean weight of 18.9 g and mean condition factor of 1.09. Hatchery chinook salmon smolts (HxH) were larger than their (HxW) counterparts having a mean length of 127 mm, mean weight of 21.3 g and mean

condition factor of 1.04. Hatchery chinook salmon (HxH) released as parr had a mean length of 94 mm, mean weight of 9.1 g and mean condition factor of 1.05. Wild steelhead trout averaged 173 mm in length, 52.7 g in weight and had a mean condition factor of 0.98. Hatchery steelhead trout were larger than their wild counterparts averaging 208 mm in length, 86.1 g in weight and 0.93 in condition factor. Condition factors of hatchery steelhead declined the third week after release in the Imnaha River and remained at lower levels through mid-June.

Total smolt yield from the Imnaha River subbasin could not be estimated for the 1995 spring sampling period. Trapping interruptions caused by periods of excessive discharge and trap malfunctions made trap efficiency trials and continuous data collection difficult. Point estimates of smolt yield for certain species and origins were derived during periods where trap efficiency trials were sufficient.

Two pulses in wild chinook smolt outmigration from the Imnaha River were observed during the study period. The most concentrated period of outmigration occurred between March 28 - 31 when 710 wild chinook were caught with an estimated emigration of up to 3,300 wild chinook smolts/day from the Imnaha River. This spike in emigration coincided with a hatchery chinook salmon release (March 28).

Oregon Department of Fish and Wildlife (ODFW) released a total of 590,069 hatchery reared chinook salmon into the Imnaha River between March 28 and May 5. Approximately 68% of the 327,125 hatchery chinook salmon released on March 28 were estimated to have emigrated past the trap site within six days. Additional movements were observed in April and May, all of which were coincident with ODFW releases. Hatchery chinook salmon smolts were captured in small numbers throughout June.

Wild steelhead trout smolts were first sampled at the trap February 8. The peak in emigration (from trap catch) occurred from April 26 to May 3 with the highest single day trap catch being 80 on March 30. Outmigrating wild steelhead trout smolts were captured throughout the rest of the reporting period, although only small numbers were trapped in June.

ODFW released approximately of 338,500 hatchery steelhead trout smolts in Little Sheep Creek and the Imnaha River between April 28 and May 1. During the study period, 2% of the hatchery reared steelhead were captured in the trap. River conditions prevented the accurate sampling of hatchery steelhead trout. Catch rates peaked on May 3 when 1,840 fish were captured. At the conclusion of the study period hatchery steelhead trout smolts were still being caught at an average of 30 fish per day.

Mortality rates due to trapping (handling) and PIT tagging were 0.78% for wild chinook salmon, 0.05% for hatchery chinook salmon(HxW), 1.67 for hatchery chinook

(HxH), 1.39% for wild steelhead trout, and 1.59% for hatchery steelhead trout smolts. Trapping caused more mortality than PIT tagging for each group of fish.

We interrogated 269 (10.8%) of the 2,494 PIT tagged hatchery chinook salmon smolts, released by ODFW from the Imnaha River acclimation pond on March 28, 15 (3%) of the 493 released on April 5, 28 (6%) of the 496 released on April 24, and 8 (2%) of the 491 released on April 26. The majority of observations were within two days after release. We also interrogated five (0.34%) of the 1,484 PIT tagged hatchery steelhead trout released from the Little Sheep Creek site. These fish were observed immediately after release on May 2 and May 3.

Snake River discharge measured at the Anatone gauge station, ranged from 27.7 to 47.0 kcfs from February 1 to late April and peaked at 118.0 kcfs on June 5. Flows declined after June 15. Discharge at LGR, paralleled increases in Snake River flows observed at the Anatone gauge station, steadily increasing from May 1 to June 6 where it peaked at 148.9 kcfs. Steady decline in flows at LGR was observed after June 6 but remained above 102.1 kcfs through the remainder of the study period. The water spill period at LGR was initiated on May 3 and occurred continuously through June 22, when spill ended.

We PIT tagged and released 421 wild chinook salmon smolts during the study period. Cumulative interrogations at Snake River and Columbia River dams were 78.4% ($n = 330$). Cumulative interrogations ranged from 74.3% for fish tagged in late April to 83.1% for fish tagged in mid-April. Arrival timing was mainly representative of fish that were tagged during April; 394 of 421 PIT tagged wild chinook were tagged and released in April. Imnaha River wild chinook salmon smolts arrived at LGR between April 11 and July 11 with median and 90% passage dates of May 1 and May 11, respectively. The 90% passage date for wild chinook at LGR (May 11) preceded peak Snake River and LGR flows (June 5) by 26 days. Wild chinook smolts passed Little Goose Dam between April 15 and July 15. The median passage date at LGO was May 7 and 90% of wild chinook smolt passage occurred by May 20. Peaks in arrival occurred in early to mid-May at the three Snake River dams. Mean travel time of PIT tagged wild chinook salmon from the Imnaha River screw trap to LGR ranged from 15 d for fish tagged in early April to 8.4 d for fish tagged in late April. Mean travel time was less for wild chinook salmon compared to hatchery chinook salmon PIT tagged and released at the same time.

A total of 747 hatchery chinook salmon smolts were PIT tagged and released in the Imnaha River during the study period. Of these, 445 were hatchery x wild crosses PIT tagged and released at dark (NPT investigations) and 302 were hatchery x hatchery crosses which were released approximately one hour after tagging (FPC investigations). Of the 747 PIT tagged hatchery chinook salmon smolts released at the Imnaha River trap, 58.9% of the NPT fish were interrogated compared to 56.6% of the

FPC fish. Trends in cumulative interrogations for weekly release groups were similar for both NPT and FPC fish over time. Hatchery chinook salmon smolts arrived at Lower Granite Dam from April 13 to June 7, at Little Goose Dam from April 26 to June 11, at Lower Monumental Dam from April 27 to June 10, and at McNary Dam from April 29 to June 9. Median and 90% passage dates for NPT fish occurred at Lower Granite and Little Goose Dams on May 2 and May 13, May 10 and May 20, respectively. Arrival timing of FPC fish followed similar trends as the NPT fish but had median and 90% passage dates of up to six days later. Peak arrival of NPT tagged hatchery chinook salmon at Lower Granite Dam occurred in early May, whereas arrival of FPC fish followed a bimodal distribution; peaking in both early and mid-May. Mean travel time of NPT tagged hatchery chinook salmon smolts to Lower Granite Dam ranged from 21.5 d for fish tagged in early April to 12.7 d for tag groups released in mid-April. Mean travel time for FPC tagged hatchery chinook salmon smolts decreased slightly over time but were similar to the NPT fish.

A total of 227 wild steelhead trout smolts were PIT tagged and released in the Imnaha River during the study period. Cumulative interrogations at Snake and Columbia River dams represented 76.2% ($n = 173$) of all PIT tagged wild steelhead trout smolts. Cumulative interrogation rates for weekly release groups ranged from 65.5% for the May 6 release group to 83.2% for the April 29 release group. Wild steelhead trout smolts arrived at Lower Granite Dam from April 28 to June 19 with median and 90% passage dates of May 2 and May 9, respectively. Peak arrival occurred during early May at Lower Granite Dam and mean travel time of wild steelhead trout from the Imnaha River trap to Lower Granite Dam ranged from 4.7 d for fish tagged in early May to 5.6 d for fish tagged in late April.

We PIT tagged 1,296 hatchery steelhead trout smolts in the Imnaha River during the study period. Cumulative interrogations observed at Snake River and Columbia River dams represented 69.2% of the PIT tagged hatchery steelhead trout. Weekly cumulative interrogations for hatchery steelhead trout ranged from 61.7 to 79.2%. Imnaha River hatchery steelhead trout smolts arrived at Lower Granite Dam from May 6 to July 12, at Little Goose Dam from May 8 to July 13, and at Lower Monumental Dam from May 9 to July 13. The median and 90% passage dates for NPT and FPC tagged hatchery steelhead smolts at LGR occurred on May 31 and June 16. The 90% passage date for PIT tagged hatchery steelhead trout at Little Goose Dam occurred on June 20. Although there were small peaks in arrival during mid-May to mid-June at the three Snake River dams, the general trend at each dam was a long protracted emigration. Only 69 PIT tagged hatchery steelhead trout smolts were detected at McNary Dam during the outmigration period. PIT tagged hatchery steelhead trout mean travel time from the Imnaha River trap to Lower Granite Dam fluctuated from 6 d for fish tagged in early June to 9.5 d for fish tagged in mid-June.

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Table A.1. Innaha River daily minimum, maximum, and mean water temperatures in degrees Celsius, February 6 - June 20, 1995.

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
02/06/95	4.9	6.5	5.8	03/06/95	3.3	5.4	4.3
02/07/95	5.3	5.8	5.5	03/07/95	2.1	5.3	4.0
02/08/95	5.0	7.0	5.8	03/08/95	3.8	5.7	4.7
02/09/95	3.3	5.3	4.3	03/09/95	5.7	8.2	7.0
02/10/95	2.9	4.2	3.6	03/10/95	7.1	8.2	7.6
02/11/95	3.3	4.6	3.9	03/11/95	6.0	7.7	6.8
02/12/95	1.3	3.7	2.4	03/12/95	5.9	6.7	6.3
02/13/95	0.1	1.2	0.6	03/13/95	5.6	7.3	6.4
02/14/95	0.1	0.8	0.4	03/14/95	6.3	8.0	7.2
02/15/95	0.1	1.2	0.6	03/15/95	6.3	7.9	6.9
02/16/95	0.7	3.8	2.0	03/16/95	5.3	6.8	6.1
02/17/95	3.5	5.6	4.5	03/17/95	5.1	7.1	6.2
02/18/95	4.4	6.8	5.5	03/18/95	6.7	7.1	6.9
02/19/95	7.0	10.0	8.5	03/19/95	6.1	7.7	6.9
02/20/95	8.1	10.6	9.4	03/20/95	6.6	8.5	7.4
02/21/95	7.0	9.5	8.1	03/21/95	6.4	8.1	7.2
02/22/95	6.6	8.1	7.3	03/22/95	5.2	7.3	6.3
02/23/95	5.1	7.4	6.4	03/23/95	5.8	6.7	6.3
02/24/95	6.4	9.3	7.6	03/24/95	5.6	6.4	6.0
02/25/95	6.7	8.4	7.5	03/25/95	4.9	6.7	5.8
02/26/95	6.8	8.7	7.7	03/26/95	4.5	6.9	5.6
02/27/95	4.8	7.3	5.9	03/27/95	4.9	7.1	6.1
02/28/95	2.5	4.6	3.8	03/28/95	5.1	7.1	6.2
03/01/95	1.8	4.0	3.0	03/29/95	5.1	7.6	6.3
03/02/95	1.3	4.3	2.9	03/30/95	5.5	7.9	6.6
03/03/95	3.3	4.9	4.1	03/31/95	6.3	10.1	8.0
03/04/95	4.4	6.0	5.1	04/01/95	7.8	9.5	8.7
03/05/95	4.4	5.4	4.9	04/02/95	5.8	10.0	7.9

Table A.1. (Cont)

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
04/03/95	6.7	10.6	8.6	05/01/95	7.8	9.6	8.4
04/04/95	8.3	11.0	9.7	05/02/95	7.8	10.0	8.9
04/05/95	9.2	11.0	10.0	05/03/95	8.1	9.8	9.0
04/06/95	9.0	10.3	9.6	05/04/95	7.8	9.3	8.6
04/07/95	8.4	9.5	9.0	05/05/95	8.5	9.3	8.9
04/08/95	6.6	8.2	7.5	05/06/95	8.0	8.5	8.2
04/09/95	6.0	7.3	6.7	05/07/95	7.6	8.3	7.9
04/10/95	5.3	8.2	6.8	05/08/95	8.2	8.7	8.4
04/11/95	7.1	8.5	7.8	05/09/95	8.5	9.2	8.7
04/12/95	6.9	8.5	7.8	05/10/95	8.9	9.2	9.1
04/13/95	6.8	8.5	7.8	05/11/95	8.9	9.3	9.1
04/14/95	5.5	7.4	6.4	05/12/95	8.5	9.0	8.7
04/15/95	4.6	8.1	6.3	05/13/95	8.4	8.7	8.5
04/16/95	4.9	8.6	6.7	05/14/95	8.3	8.9	8.6
04/17/95	5.8	8.2	7.3	05/15/95	8.9	9.3	9.1
04/18/95	6.9	7.8	7.2	05/16/95	9.2	10.1	9.6
04/19/95	6.6	8.0	7.1	05/17/95	9.6	10.0	9.8
04/20/95	6.0	7.2	6.6	05/18/95	9.7	10.0	9.8
04/21/95	6.4	9.4	7.7	05/19/95	9.4	10.0	9.8
04/22/95	7.4	10.9	9.1	05/20/95	9.6	10.3	9.9
04/23/95	7.6	11.6	9.5	05/21/95	10.0	10.6	10.2
04/24/95	8.7	12.4	10.5	05/22/95	9.9	10.4	10.2
04/25/95	9.5	11.6	10.5	05/23/95	9.9	11.4	10.4
04/26/95	7.9	11.2	9.6	05/24/95	9.4	11.6	10.6
04/27/95	9.2	11.5	10.3	05/25/95	9.5	11.1	10.3
04/28/95	8.9	10.6	9.7	05/26/95	9.2	10.4	9.9
04/29/95	7.8	8.8	8.2	05/27/95	9.0	12.2	10.6
04/30/95	6.5	10.0	8.1	05/28/95	10.0	13.1	11.5

Table A.1. (Cont.)

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
05/29/95	11.1	13.6	12.4				
05/30/95	11.2	13.6	12.5				
05/31/95	11.0	12.9	12.0				
06/01/95	10.8	11.9	11.3				
06/02/95	10.8	11.8	11.4				
06/03/95	10.6	12.4	11.5				
06/04/95	10.3	13.1	11.8				
06/05/95	7.9	13.0	10.4				
06/06/95	7.1	7.8	7.5				
06/07/95	7.0	7.6	7.3				
06/08/95	9.8	11.8	10.6				
06/09/95	9.6	13.0	11.0				
06/10/95	10.1	14.4	12.2				
06/11/95	12.3	14.7	13.4				
06/12/95	11.6	14.0	12.9				
06/13/95	12.3	13.3	12.8				
06/14/95	11.3	12.5	11.7				
06/15/95	10.6	11.5	10.8				
06/16/95	10.6	11.4	11.0				
06/17/95	10.9	11.6	11.2				
06/18/95	10.0	10.9	10.4				
06/19/95	9.0	10.2	9.7				
06/20/95	8.5	10.5	9.4				

Table A.2. Imnaha River daily staff gauge measurements and discharge readings from USGS gauge 13292000 at Imnaha, OR. February 6 – June 20, 1995 (NR=NO READING, Q=DISCHARGE, STAFF MEASURE IN METERS.)

DATE	STAFF	Q	DATE	STAFF	Q
02/06/95	NR	506	03/18/95	NR	1400
02/07/95	0.75	510	03/19/95	NR	1450
02/08/95	0.75	485	03/20/95	NR	1450
02/09/95	0.73	441	03/21/95	NR	1520
02/10/95	0.70	406	03/22/95	0.95	1390
02/11/95	NR	385	03/23/95	0.92	1280
02/12/95	NR	363	03/24/95	0.88	1110
02/13/95	NR	332	03/25/95	NR	982
02/14/95	0.62	281	03/26/95	NR	881
02/15/95	NR	289	03/27/95	0.87	803
02/16/95	NR	288	03/28/95	0.85	756
02/17/95	0.63	283	03/29/95	0.84	727
02/18/95	NR	278	03/30/95	0.83	700
02/19/95	NR	283	03/31/95	0.82	688
02/20/95	NR	407	04/01/95	0.81	724
02/21/95	NR	626	04/02/95	NR	692
02/22/95	0.82	691	04/03/95	NR	683
02/23/95	0.82	672	04/04/95	0.82	736
02/24/95	NR	687	04/05/95	0.88	908
02/25/95	NR	759	04/06/95	0.94	1140
02/26/95	NR	742	04/07/95	NR	1520
02/27/95	NR	690	04/08/95	NR	1850
02/28/95	0.80	620	04/09/95	NR	1590
03/01/95	0.77	534	04/10/95	NR	1340
03/02/95	0.74	505	04/11/95	NR	1220
03/03/95	0.72	476	04/12/95	NR	1140
03/04/95	NR	444	04/13/95	1.00	1340
03/05/95	NR	415	04/14/95	NR	1350
03/06/95	NR	372	04/15/95	NR	1270
03/07/95	0.67	340	04/16/95	NR	1180
03/08/95	NR	345	04/17/95	NR	1100
03/09/95	NR	450	04/18/95	0.94	1030
03/10/95	0.89	997	04/19/95	0.92	960
03/11/95	NR	2340	04/20/95	0.90	906
03/12/95	NR	1830	04/21/95	0.89	843
03/13/95	NR	1460	04/22/95	NR	791
03/14/95	NR	1320	04/23/95	NR	793
03/15/95	NR	1790	04/24/95	0.90	886
03/16/95	NR	1610	04/25/95	0.96	1060
03/17/95	NR	1430	04/26/95	0.98	1130

Table A.2. (continued)

DATE	STAFF.	Q	DATE	STAFF	Q
04/27/95	1.00	1260	06/06/95	1.24	1940
04/28/95	1.08	1580	06/07/95	1.12	1600
04/29/95	NR	1680	06/08/95	0.98	1430
04/30/95	NR	1760	06/09/95	1.03	1350
05/01/95	NR	1790	06/10/95	NR	1300
05/02/95	1.24	1820	06/11/95	NR	1510
05/03/95	1.23	1810	06/12/95	1.01	1620
05/04/95	1.19	1730	06/13/95	NR	1650
05/05/95	1.16	1760	06/14/95	1.12	1640
05/06/95	NR	2240	06/15/95	1.10	1630
05/07/95	NR	4030	06/16/95	NR	1590
05/08/95	NR	3680	06/17/95	NR	1820
05/09/95	NR	3100	06/18/95	NR	2070
05/10/95	NR	2820	06/19/95	1.25	2140
05/11/95	NR	2810	06/20/95	1.21	1900
05/12/95	NR	2820			
05/13/95	NR	2470			
05/14/95	NR	2180			
05/15/95	NR	2060			
05/16/95	NR	2080			
05/17/95	1.36	2240			
05/18/95	1.36	2250			
05/19/95	1.31	2120			
05/20/95	NR	2040			
05/21/95	NR	2040			
05/22/95	1.30	2050			
05/23/95	1.28	1970			
05/24/95	1.22	1870			
05/25/95	1.20	1810			
05/26/95	1.18	1740			
05/27/95	NR	1640			
05/28/95	NR	1640			
05/29/95	NR	1700			
05/30/95	NR	1830			
05/31/95	NR	1980			
06/01/95	1.26	2010			
06/02/95	1.22	1980			
06/03/95	NR	2010			
06/04/95	NR	2040			
06/05/95	1.29	2410			

Table B.1. Catch composition of Imnaha River screw trap, February, 1995.

Date	Chinook				Steelhead				Total Catch
	Wild	Hatchery (HxW)	Hatchery (HxH)	Hatchery Parr release	Total	Wild	Parr/w	Hatchery	
7	12	0	0	0	12	0	0	0	12
8	8	0	0	0	8	3	0	0	11
9	25	0	0	2	27	0	0	0	27
10	7	0	0	0	7	1	0	0	8
*11									
*12									
*13									
*14									
*15									
*16									
17	4	0	0	0	4	0	0	0	4
*18									
*19									
*20									
*21									
22	3	0	0	0	3	3	0	0	6
23	6	0	0	0	16	0	0	0	16
*24									
*25									
*26									
*27									
28	11	0	0	1	12	2	0	0	14
Total	86	0	0	3	89	9	0	0	98

* Trap not operated. See details in Table 4.

Table B.2. Catch composition of Innaha River screw trap, March, 1995. Estimated catch appear in italics.

Date	Chinook				Steelhead				Total Catch
	Wild	Hatchery (HxW)	Hatchery (HxH)	Hatchery Parr release	Total	Wild	Parr/W	Hatchery	Total
1	15	0	0	0	15	0	0	0	15
2	18	0	0	2	20	1	0	0	21
3	18	0	0	1	19	0	0	0	19
*4	14	0	0	1	15	0	0	0	15
*5	10	0	0	0	10	0	0	0	10
*6	7	0	0	0	7	0	0	0	7
7	4	0	0	1	5	0	0	0	5
*8	4	0	0	0	4	0	0	0	4
*9	3	0	0	0	3	0	0	0	3
~10	3	0	0	0	3	0	0	0	3
*11									
*12									
*13									
*14									
*15									
*16									
*17									
*18									
*19									
*20									
*21									
~22	32	0	0	1	33	4	0	0	37
~23	37	0	0	2	39	1	0	0	40
~24	60	0	0	0	60	2	0	0	62
*25	66	0	0	4	70	4	0	0	74
*26	72	0	0	9	81	5	0	0	86
27	78	0	0	14	92	6	0	0	98
28	102	0	0	15	117	9	1	0	127
#29	163	8,446	0	0	8,609	4	0	0	8,613
#30	344	40,993	0	0	41,337	80	2	0	41,419
#31	101	4,790	0	2	4,893	4	0	0	4,897
Total	1,151	54,229	0	52	55,432	120	3	0	123
									55,555

* Trap not operated. See details in Table 4.

~ Irregular trap operation.

Expanded counts from subsample.

Table B.3. Catch composition of Imnaha River screw trap, April, 1995. Estimated catch appear in italics.

Date	Chinook				Steelhead				Total Catch
	Wild	Hatchery (HxW)	Hatchery (HxH)	Hatchery Parr release	Total	Wild	Parr/W	Hatchery	
1	70	1,640	0	0	1,710	13	0	0	1,723
*2	68	1,238	0	0	1,306	10	0	0	1,316
*3	66	836	0	1	903	7	0	0	910
4	64	434	0	1	499	4	0	0	503
5	41	194	0	3	238	5	0	0	243
#6	424	639	6,043	1	7,107	7	0	11	7,125
~7	10	11	173	0	194	0	0	0	194
*8									
*9									
**10	0	0	0	0	0	0	0	0	0
**11	0	0	0	0	0	0	0	0	0
**12	0	0	0	0	0	0	0	0	0
**13	26	3	27	0	56	0	0	0	56
**14	0	0	0	0	0	0	0	0	0
*15									
*16									
*17									
18	35	22	5	0	62	16	0	1	79
19	80	53	4	0	137	41	0	0	178
20	78	45	10	0	133	27	0	1	161
21	93	29	4	1	127	22	0	0	149
*22	76	29	3	1	109	22	0	0	131
*23	59	30	3	0	92	23	0	0	115
24	41	30	2	0	73	24	0	0	97
25	34	2,611	0	0	2,645	34	0	1	2,680
#26	54	2,131	0	0	2,185	49	0	1	2,235
#27	61	1,507	2,864	0	4,432	51	0	0	4,483
28	65	214	1,687	0	1,966	57	0	0	2,023
*29	52	163	1,267	0	1,482	51	0	0	1,533
*30	39	112	847	0	998	45	0	0	1,043
Total	1,536	11,971	12,939	8	26,454	508	0	15	26,977

* Trap not operated. See details in Table 4.

** Operated small trap only. Large trap was not operated between 4/8 - 4/17/95.

~|regular trap operation.

Expanded counts from subsample.

Table B.4. Catch composition of Imnaha River screw trap, May, 1995. Estimated catch appear in italics.

Date	Chinook				Steelhead			Total Catch
	Wild	Hatchery (HxW)	Hatchery (HxH)	Hatchery Parr release	Wild	Parr/W	Hatchery	
*1	26	61	427	0	39	0	0	553
#2	12	9	6	0	32	0	693	752
#~3	11	6	16	0	43	0	1,840	1,916
~4	21	12	10	0	22	0	1,444	1,509
~5	30	11	17	0	21	0	852	931
*6					0			0
*7					0			0
*8					0			0
*9					0			0
*10					0			0
*11					0			0
*12					0			0
*13					0			0
*14					0			0
*15					0			0
*16					0			0
~17	9	6	8	0	15	1	76	115
~18	12	8	4	0	27	1	94	146
~19	14	13	9	0	21	0	102	159
*20	11	12	8	0	24	0	148	203
*21	8	11	6	0	26	0	194	245
~22	6	10	5	0	28	1	240	290
~23	5	2	5	0	23	0	205	240
~24	10	11	0	0	20	0	273	314
~25	4	3	0	0	7	0	181	195
~26	7	7	2	0	29	0	308	353
*27					0			0
*28					0			0
*29					0			0
*30					0			0
*31					0			0
Total	186	182	523	0	377	3	6,650	7,921

* Trap not operated. See details in Table 4.

~ Irregular trap operation.

Expanded counts from subsample.

Table B.5. Catch composition of Imnaha River screw trap, June, 1995. Estimated catch appear in italics.

Date	Chinook				Steelhead				Total Catch
	Wild	Hatchery (HvH)	Hatchery (HvH)	Parr release	Total	Wild	Parr/w	Hatchery	
~1	5	10	1	0	16	11	10	157	194
2	5	8	0	0	13	9	3	226	251
*3	4	8	0	0	12	7	2	197	218
*4	3	7	0	0	10	5	1	168	184
~5	3	7	0	0	10	4	1	139	154
~6	2	2	0	0	4	2	0	58	64
~7	5	5	0	0	10	1	0	30	41
8	5	11	0	0	16	1	2	50	69
9	11	5	0	0	16	0	0	42	58
*10	9	6	0	0	15	1	0	49	65
*11	7	8	0	0	15	2	0	57	74
~12	5	10	0	0	15	3	1	65	84
*13	3	9	0	0	12	3	1	60	76
~14	2	8	0	0	10	3	1	56	70
15	1	10	0	0	11	0	0	43	54
*16	1	8	0	0	9	0	0	39	48
*17	2	6	0	0	8	0	0	35	43
*18	3	4	0	0	7	0	0	31	38
~19	4	2	0	0	6	0	1	28	35
20	2	8	0	0	10	0	0	20	30
Total	82	142	1	0	225	52	23	1,550	1,850

* Trap not operated. See details in Table 4.

~ Irregular trap operation.

Table C. Mark and recapture data for trap efficiency trials conducted at the Imnaha River screw trap, February 6 -- June 20, 1995. (MREL = Number marked and released, RCAP = Number recaptured, TREF = Trap efficiency).

DATE	CH-W			CH-H			RBT-W			RBT-H		
	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF
02/08/95	12	0	*0.00									
02/10/95	25	4	0.16									
03/01/95	10	2	0.20	1	0	*0.00						
03/02/95	15	2	0.13									
03/03/95	18	1	0.06	2	2	*1.00						
03/23/95	38	4	0.11	1	0	*0.00						
03/24/95	34	2	0.06	2	0	*0.00						
03/28/95	23	3	0.13	6	1	*0.17						
04/01/95	62	7	0.11	201	33	0.16						
04/05/95				99	36	0.36	3	0	*0.00			
04/06/95							4	1	*0.25			
04/19/95	35	5	0.14				16	4	0.25			
04/20/95							40	11	0.28			
04/21/95				33	7	0.21	27	6	0.22			
04/25/95	41	4	0.10	100	5	0.05						
04/28/95				150	7	0.05						
05/04/95										198	18	0.09
05/05/95	29	2	0.07							100	9	0.09
05/18/95	9	0	*0.00	13	0	*0.00	14	0	*0.00	71	6	0.09
05/19/95	12	0	*0.00	11	1	0.09	26	2	0.08			
05/23/95							28	1	0.04	89	7	0.08
05/24/95	8	0	*0.00	19	2	0.11						
05/25/95				11	0	*0.00				95	6	0.06
05/26/95	13	0	*0.00	13	1	0.08	27	0	*0.00			
06/02/95	4	0	*0.00	10	0	*0.00	11	1	0.09	33	3	0.09
06/06/95	3	0	*0.00	6	0	*0.00	4	1	*0.25	78	5	0.06
06/09/95				15	3	0.20				45	4	0.09
06/15/95				8	0	*0.00				29	8	0.28
06/20/95	3	0	*0.00	2	0	*0.00				26	2	0.08

* Trap efficiency trials not used in analysis.

Table D.1. Mean daily length, weight, and condition factor of wild chinook salmon sampled at the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
2/07	12	89	6.5	6.8	1.5	0.95	0.03
2/08	8	84	7.7	5.9	1.6	0.98	0.05
2/09	25	92	8.5	7.8	2.1	0.98	0.03
2/10	7	90	8.5	7.3	1.9	0.98	0.04
2/17	4	95	12.4	8.8	4.1	0.96	0.03
2/22	3	101	3.6	10.5	0.7	1.02	0.07
2/23	16	95	6.0	9.0	1.9	1.03	0.05
2/28	11	93	9.8	8.6	2.6	1.03	0.04
3/01	15	96	8.5	9.1	2.9	1.01	0.03
3/02	18	92	9.0	7.9	2.1	1.01	0.08
3/03	18	93	8.1	8.6	2.2	1.05	0.06
3/07	4	99	5.2	10.5	1.7	1.07	0.02
3/22	30	97	8.3	10.0	2.3	1.09	0.05
3/23	31	98	13.4	10.7	7.2	1.06	0.06
3/24	31	95	7.2	9.5	1.8	1.10	0.11
3/27	23	94	6.5	8.8	2.1	1.03	0.09
3/28	31	97	6.8	9.6	2.0	1.04	0.04
3/29	23	100	12.8	11.3	4.9	1.07	0.06
3/30	10	99	8.8	10.8	3.4	1.09	0.05
4/01	42	99	11.0	10.8	4.3	1.08	0.12
4/04	48	100	7.2	9.7	2.3	0.97	0.05
4/05	37	104	14.0	10.8	2.4	0.97	0.13
4/13	26	100	5.5	9.9	1.7	1.00	0.07
4/18	30	100	7.1	11.1	2.2	1.10	0.08
4/19	59	103	7.8	11.4	2.7	1.03	0.05
4/20	78	100	6.0	11.2	2.3	1.10	0.07
4/21	30	97	7.3	10.2	2.3	1.10	0.10
4/25	34	106	8.0	12.6	2.9	1.04	0.05
4/26	29	102	8.9	11.6	2.8	1.08	0.06
4/27	40	103	9.6	11.8	2.0	1.11	0.28
4/28	46	106	8.0	13.1	2.8	1.09	0.10
5/02	6	104	5.1	13.0	2.4	1.14	0.06
5/03	11	100	8.5	12.0	2.6	1.16	0.06
5/04	20	100	9.5	11.9	3.1	1.16	0.06
5/05	30	98	7.8	10.8	2.7	1.13	0.06
5/17	9	107	10.7	13.7	3.8	1.09	0.06
5/18	12	102	13.1	12.9	4.9	1.19	0.08
5/19	14	97	7.7	11.3	3.0	1.21	0.18
5/22	6	105	12.0	13.4	4.4	1.11	0.04
5/23	5	97	10.7	11.0	4.0	1.15	0.05
5/24	10	104	17.8	13.3	7.2	1.12	0.06
5/25	4	106	5.6	11.8	1.2	1.01	0.08
5/26	7	100	8.6	11.5	2.5	1.14	0.06

Table D.1. (continued)

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
6/01	5	96	6.3	9.9	1.7	1.10	0.02
6/02	5	100	3.2	10.7	1.1	1.06	0.06
6/05	3	100	12.8	9.4	2.2	0.94	0.14
6/06	2	95	7.5	8.6	1.5	1.02	0.06
6/07	5	97	3.4	10.3	1.1	1.11	0.08
6/08	5	96	7.4	9.5	2.0	1.05	0.06
6/09	11	104	11.3	12.2	3.4	1.07	0.08
6/12	5	105	9.4	13.2	2.8	1.13	0.07
6/14	2	98	5.0	10.7	1.0	1.13	0.06
6/15	1	104	—	10.7	—	0.95	—
6/19	4	97	4.2	11.2	1.1	1.24	0.05
6/20	2	108	8.5	15.7	4.4	1.22	0.06

Table D.2. Mean daily length, weight, and condition factor of hatchery chinook salmon (HxH crossed released parr) sampled at the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
2/09	2	88	2.5	6.9	0.8	1.03	0.04
2/28	1	85		6.2	—	1.01	—
3/02	2	92	2.5	7.7	0.6	1.01	co.01
3/03	1	87		6.9		1.05	—
3/07	1	88	—	8.1	—	1.19	—
3/22	1	98		10.0		1.06	—
3/23	2	90	5.0	7.4	1.5	1.00	0.04
3/27	7	96	5.0	9.4	1.8	1.06	0.07
3/28	14	99	5.3	10.6	2.2	1.07	0.05
3/31	1	88		7.3	—	1.07	—
4/05	1	89	—	6.1	—	0.87	—
4/21	1	83		5.9		1.03	—

Table 0.3. Mean daily length, weight, and condition factor of hatchery chinook salmon (HxH crossed) sampled at the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
4/06	101	127	7.8	22.2	4.5	1.09	0.08
4/18	5	121	3.1	18.1	1.7	1.01	0.03
4/19	4	119	5.6	18.2	2.0	1.09	0.05
4/20	10	121	4.4	18.3	2.1	1.04	0.07
4/21	1	120		18.9	—	1.09	—
4/27	107	127	7.1	21.1	3.5	1.02	0.12
4/28	95	126	8.9	20.9	5.1	1.02	0.07
5/02	3	124	4.5	20.1	2.6	1.06	0.02
5/03	6	121	4.5	18.4	2.6	1.03	0.05
5/04	10	122	4.8	19.1	1.8	1.06	0.05
5/05	16	123	5.4	18.4	2.3	1.00	0.06
5/17	8	135	8.5	24.7	4.5	0.99	0.04
5/18	4	140	7.4	29.1	5.2	1.06	0.05
5/19	9	135	7.9	25.7	4.3	1.05	0.10
5/22	5	139	7.9	27.0	4.3	1.00	0.05
5/23	4	127	3.5	19.7	2.8	0.95	0.06
5/26	2	125	0.0	18.5	0.8	0.95	0.04
6/01	1	103	—	12.3	—	1.13	—

Table D.4. Mean daily length, weight, and condition factor of hatchery chinook salmon (**HxW** crossed) sampled at the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
3/29	5	130	5.8	23.4	2.5	1.06	0.06
3/30	21	127	6.1	23.7	4.2	1.16	0.08
3/31	12	127	7.7	23.1	4.6	1.12	0.06
4/01	8	98	2.8	9.8	1.3	1.03	0.13
4/04	33	123	10.1	20.4	4.5	1.07	0.06
4/05	141	124	8.2	20.7	4.4	1.07	0.08
4/06	3	103	6.8	11.1	2.5	1.01	0.02
4/18	22	111	10.5	14.8	3.8	1.06	0.06
4/19	15	120	5.6	17.8	2.7	1.03	0.06
4/20	42	108	16.2	14.7	6.9	1.11	0.09
4/21	21	111	12.2	15.3	5.0	1.10	0.15
4/25	266	124	7.6	20.3	3.5	1.07	0.07
4/26	105	125	7.4	21.4	3.8	1.10	0.08
4/27	30	124	6.9	21.0	3.7	1.10	0.09
5/02	4	109	9.9	15.5	3.4	1.18	0.07
5/03	5	103	7.8	12.3	2.1	1.13	0.09
5/04	12	110	11.4	15.5	4.3	1.13	0.10
5/05	11	122	7.5	19.3	3.0	1.05	0.09
5/17	5	111	13.8	15.1	4.4	1.08	0.12
5/18	8	106	5.7	14.7	2.3	1.23	0.09
5/19	13	109	11.6	15.0	4.1	1.13	0.10
5/22	10	106	9.6	14.0	3.8	1.14	0.05
5/23	2	111	12.5	14.1	5.1	1.00	0.04
5/24	11	108	11.5	15.2	4.2	1.19	0.14
5/25	3	105	1.7	12.1	0.6	1.05	0.02
5/26	7	102	6.4	11.8	2.3	1.10	0.06
6/01	10	103	4.4	12.8	2.2	1.17	0.10
6/02	8	107	4.7	14.5	2.1	1.18	0.15
6/05	6	108	9.2	14.0	3.4	1.10	0.09
6/06	2	109	2.0	15.2	0.4	1.18	0.04
6/07	5	107	2.8	13.8	1.7	1.12	0.06
6/08	10	109	5.2	14.3	2.4	1.10	0.05
6/09	5	107	7.5	14.1	2.5	1.13	0.04
6/12	10	107	5.4	13.6	2.0	1.09	0.04
6/14	8	107	4.9	14.9	2.4	1.21	0.06
6/15	10	110	6.5	15.3	2.7	1.15	0.04
6/19	2	109	2.0	14.6	0.1	1.13	0.06
6/20	7	112	10.1	17.0	5.1	1.18	0.05

Table D.5. Mean daily length, weight, and condition factor of wild steelhead trout sampled at the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
2/08	3	109	12.7	12.1	4.3	0.89	0.05
2/10	1	128		20.0		0.95	
2/22	3	125	6.4	18.6	2.4	0.95	0.05
2/28	2	132	4.0	23.5	1.8	1.02	0.01
3/02	1	195		65.2		0.88	
3/22	4	170	27.3	51.7	22.9	0.98	0.05
3/23	1	165		41.2	—	0.92	
3/24	2	176	6.0	49.8	5.2	0.91	0.01
3/27	6	192	18.1	68.1	21.5	0.93	0.05
3/28	9	174	26.1	52.4	21.9	0.94	0.03
3/29	3	185	25.3	65.0	30.4	0.95	0.04
4/01	5	162	30.9	48.3	24.5	1.06	0.13
4/04	4	161	9.9	41.2	7.7	0.99	0.10
4/05	5	145	31.3	34.4	16.4	1.02	0.08
4/06	2	170	19.5	47.6	12.6	0.97	0.08
4/18	16	187	20.6	67.1	22.2	0.99	0.04
4/19	30	177	14.4	53.5	14.6	0.94	0.05
4/20	27	174	15.9	53.5	14.8	0.99	0.07
4/21	22	174	15.0	54.2	13.8	1.02	0.08
4/24	23	185	14.8	62.4	15.0	0.97	0.05
4/25	29	183	17.4	59.1	18.8	0.93	0.05
4/26	25	186	14.4	63.0	15.4	0.96	0.05
4/27	9	186	10.9	61.1	11.4	0.94	0.08
4/28	51	184	21.9	62.0	25.7	0.95	0.06
5/02	20	181	17.1	59.3	16.6	0.97	0.06
5/03	27	172	17.4	52.4	15.6	1.00	0.05
5/04	21	172	18.2	51.2	19.6	0.96	0.09
5/05	18	169	13.6	46.8	12.1	0.95	0.06
5/17	14	166	14.9	45.3	12.8	0.98	0.05
5/18	26	162	14.4	46.1	11.2	1.07	0.11
5/19	20	174	16.8	54.3	17.4	1.00	0.08
5/22	28	168	14.2	47.5	12.5	0.98	0.06
5/23	23	170	14.0	49.3	14.8	0.98	0.07
5/24	20	168	17.9	49.1	13.9	1.01	0.06
5/25	7	166	8.2	43.5	7.0	0.93	0.05
5/26	29	162	13.0	43.3	10.7	1.00	0.08
6/01	11	161	11.8	42.8	9.0	1.02	0.04
6/02	9	165	17.8	42.6	10.6	0.95	0.17
6/05	4	163	8.9	45.8	5.9	1.07	0.04
6/06	2	170	4.0	48.9	6.3	0.99	0.06
6/07	1	157	—	38.6	—	1.00	
6/08	1	163	—	43.7	—	1.01	
6/12	3	148	4.0	33.3	1.8	1.02	0.03
6/14	3	164	8.2	44.8	6.0	1.01	0.04

Table D.6. Mean daily length, weight, and condition factor of hatchery steelhead trout sampled at the Imnaha River screw trap, February 6 – June 20, 1995.

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
4/06	1	227		83.5		0.71	—
4/18	1	223		122.9		1.10	—
4/20	1	197		69.7	—	0.91	
4/25	1	266		172.5	—	0.92	—
4/26	1	256		152.5		0.91	—
5/02	102	208	14.6	92.0	20.8	1.01	0.06
5/03	250	210	16.1	95.9	23.6	1.02	0.06
5/17	30	203	18.4	82.8	24.8	0.96	0.07
5/18	93	209	18.9	86.0	25.0	0.93	0.08
5/19	101	208	19.1	86.3	25.7	0.93	0.05
5/22	30	211	18.8	92.2	26.8	0.95	0.05
5/23	100	209	18.2	84.2	23.7	0.90	0.05
5/24	100	206	18.5	79.4	24.9	0.89	0.06
5/25	144	213	19.8	89.5	29.3	0.89	0.06
5/26	30	211	21.6	91.5	31.4	0.94	0.06
6/01	102	205	18.6	79.9	24.3	0.90	0.07
6/02	98	206	18.2	79.8	21.5	0.89	0.08
6/05	30	203	19.7	77.5	24.5	0.90	0.08
6/06	56	201	16.1	74.5	18.3	0.89	0.05
6/07	29	208	12.7	81.5	16.3	0.89	0.04
6/08	30	211	20.0	88.3	26.7	0.91	0.05
6/09	42	210	17.0	85.9	23.0	0.90	0.06
6/12	59	203	19.5	79.1	26.2	0.91	0.05
6/14	30	206	23.6	83.9	35.5	0.91	0.06
6/15	30	205	22.0	79.4	25.8	0.89	0.07
6/19	26	203	17.9	79.4	21.1	0.92	0.07
6/20	20	212	17.1	88.2	25.3	0.90	0.06

Table E.I. Composition of incidental fish species captured in the Imnaha River screw trap, February, 1995.

Date	Species										Total
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	Catch
7						1			3		4
8									1		1
9						1			4		6
10											0
11											0
12											0
13											0
14											0
15											0
16											0
17											0
18											0
19											0
20											0
21											0
22											2
23					1	1					6
24											0
25											0
26											0
27											0
28											0
Total	0	0	1	0	1	3	0	0	14	0	19

STHD Adult steelhead trout

BT Bull trout

MWF Mountain whitefish

SMB Smallmouth bass

CHSL Chiselmouth

RSS Redside shiner

L N D Longnose dace

NSF Northern squawfish

BLS Bridgelip sucker

SC Sculpin

Table E.2. Composition of incidental fish species captured in the Imnaha River screw trap, March, 1995.

Date	Species										Total
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	Catch
1											0
2		1	1								2
3			1								1
4											0
5											0
6											0
7											0
8											0
9											0
10											0
11											0
12											0
13											0
14											0
15											0
16											0
17											0
18											0
19											0
20											0
21											0
22											0
23										1	1
24										1	1
25											0
26											0
27				2				3			5
28				1	1						2
29											0
30											0
31				1			2		3		6
Total	0	1	2	4	1	0	2	3	3	2	18

STHD Adult steelhead trout
 BT Bull trout
 MWF Mountain whitefish
 SMB Smallmouth bass
 CHSL Chiselmouth

RSS Redside shiner
 LND Longnose dace
 NSF Northern squawfish
 BLS Bridgelip sucker
 SC Sculpin

Table E.3. Composition of incidental fish species captured in the Imnaha River screw trap, April, 1995.

Date	Species										Total
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	Catch
1				1			20	1	2	1	25
2											0
3											0
4									8		8
5							2		3	1	6
6				1	1						2
7											0
8											0
9											0
10											0
11											0
12											0
13											0
14											0
15											0
16											0
17											0
18	1								1		2
19										1	1
20											0
21										2	3
22											0
23											0
24							2		5	1	8
25				2			3		7		12
26							1		2		3
27											0
28	1						1				2
29											0
30											0
Total	2	0	0	5	1	0	29	1	28	6	72

STHD Adult steelhead trout

BT Bull trout

MWF Mountain whitefish

SMB Smallmouth bass

CHSL Chiselmouth

RSS Redside shiner

LND Longnose dace

NSF Northern squawfish

BLS Bridgelip sucker

SC Sculpin

Table E.4. Composition of incidental fish species captured in the Imnaha River screw trap, May, 1995.

Date	Species										Total	
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	Catch	
1											0	
2											0	
3											1	
4				1							1	
5	1			2		1					4	
6											0	
7											0	
8											0	
9											0	
10											0	
11											0	
12											0	
13											0	
14											0	
15											0	
16											0	
17	1								1	1	3	
18											0	
19											0	
20											0	
21											0	
22	1							1			2	
23									1		1	
24	2										2	
25					1			1	1		3	
26											0	
27											0	
28											0	
29											0	
30											0	
31											0	
Total	5	0	0	3	1	1	0	3	3	1	1	7

STHD Adult steelhead trout
 BT Bull trout
 MWF Mountain whitefish
 SMB Smallmouth bass
 CHSL Chiselmouth

RSS Redside shiner
 LND Longnose dace
 NSF Northern squawfish
 BLS Bridgelip sucker
 SC Scupin

Table E.5. Composition of incidental fish species captured in the Imnaha River screw trap, June, 1995.

Date	Species										Total Catch
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	
1									3		3
2	1								2		3
3											0
4											0
5									2		3
6								1	4		5
7									14		16
8									8		8
9	1								5		6
10											0
11											0
12									4		4
13											0
14								1	7		9
15									9		9
16											0
17											0
18											0
19									64		64
20									65		65
Total	2	2	1	0	1	0	0	2	187	0	195

STHD Adult steelhead trout
 BT Bull trout
 MWF Mountain whitefish
 SMB Smallmouth bass
 CHSL Chiselmouth

RSS Redside shiner
 LND Longnose dace
 NSF Northern squawfish
 BLS Bridgelip sucker
 SC Sculpin

Table F.1. Summary of wild and hatchery chinook salmon smolt PIT tag groups released at the Imnaha River screw trap, March 10 – June 20, 1995.

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/05	PAK95095.NT2	C H	W	NPT	84	102	10.3
4/13	PAK95103.NT1	CH	W	NPT	26	100	9.9
4/20	PAK95109.NT1	CH	W	NPT	58	103	11.4
4/20	PAK95110.NT1	CH	W	NPT	78	101	11.2
4/26	PAK95115.NT2	CH	W	NPT	34	106	12.6
4/26	PAK95116.NT1	CH	W	NPT	28	103	11.8
4/28	PAK95117.NT1	CH	W	NPT	40	103	11.8
4/28	PAK95118.NT1	CH	W	NPT	46	106	13.1
6/08	PAK95159.NT1	CH	W	NPT	9	97	9.9
6/09	PAK95160.NT1	CH	W	NPT	11	104	12.2
6/12	PAK95163.NT1	CH	W	NPT	5	105	13.2
6/14	PAK95165.NT1	CH	W	NPT	2	98	10.7
TOTAL		CH	W		421		
4/05	PAK95095.NT1	CH	HxW	NPT	184	124	20.8
4/19	PAK95109.NT2	CH	HxW	NPT	15	120	17.8
4/20	PAK95110.NT2	CH	HxW	NPT	22	126	21.3
4/25	PAK95115.NT1	CH	HxW	NPT	224	124	20.6
SUBTOTAL		CH	HxW		445		
4/06	PAK95096.FP1	CH	HxH	FPC	100	127	22.3
4/18	PAK95108.FP1	CH	HxH	FPC	5	121	18.1
4/19	PAK95109.FP1	CH	HxH	FPC	4	119	18.2
4/27	PAK95117.FP1	CH	HxH	FPC	101	127	20.9
4/28	PAK95118.FP1	CH	HxH	FPC	92	126	20.9
SUBTOTAL		CH	HxH		302		
TOTAL HxW and HxH		CH	Both		747		

Table F.2. Summary of wild steelhead trout smolt PIT tag groups released at the Imnaha River screw trap, March 10 – June 20, 1995.

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/24	PAK95114.FP1	RBT	W	FPC	23	185	62.4
4/26	PAK95115.FP1	RBT	W	FPC	29	183	55.6
4/26	PAK95116.FP1	RBT	W	FPC	25	186	61.8
4/28	PAK95117.FP2	RBT	W	FPC	9	186	61.1
4/28	PAK95118.FP2	RBT	W	FPC	51	184	55.5
5/02	PAK95122.FP2	RBT	W	FPC	19	181	59.1
5/03	PAK95123.FP2	RBT	W	FPC	27	172	52.4
5/04	PAK95124.FP1	RBT	W	FPC	20	174	52.6
5/05	PAK95125.FP1	RBT	W	FPC	18	169	46.8
6/12	PAK95163.FP2	RBT	W	FPC	3	148	33.3
6/14	PAK95165.FP2	RBT	W	FPC	3	164	44.8
TOTAL		RBT	W		227		

Table F.3. Summary of hatchery steelhead trout smolt PIT tag groups released at the Imnaha River screw trap, March 10 – June 20, 1995.

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
5/03	PAK95123.NT1	RBT	H	NPT	150	207	82.7
5/25	PAK95145.NT1	RBT	H	NPT	150	210	73.7
SUBTOTAL		RBT	H		300		
5/02	PAK95122.FP1	RBT	H	FPC	98	208	92.3
5/03	PAK95123.FP1	RBT	H	FPC	99	210	95.9
5/18	PAK95138.FP1	RBT	H	FPC	97	209	74.3
5/19	PAK95139.FP1	RBT	H	FPC	102	206	73.2
5/23	PAK95143.FP1	RBT	H	FPC	100	209	84.2
5/24	PAK95144.FP1	RBT	H	FPC	100	206	79.4
6/01	PAK95152.FP1	RBT	H	FPC	101	205	79.8
6/02	PAK95153.FP1	RBT	H	FPC	100	206	79.6
6/06	PAK95157.FP1	RBT	H	FPC	55	202	74.7
6/07	PAK95158.FP1	RBT	H	FPC	29	208	81.5
6/09	PAK95160.FP1	RBT	H	FPC	38	209	85.2
6/12	PAK95163.FP1	RBT	H	FPC	58	204	79.5
6/14	PAK95165.FP1	RBT	H	FPC	19	208	88.6
SUBTOTAL		RBT	H		996		
TOTAL		RBT	H		1,296		

Table G.1. Releases of hatchery chinook salmon and steelhead trout smolts by ODFW in the Imnaha River, 1995.

DATE	SPECIES	ORIGIN	NUMBER RELEASED	FIN MARK	RELEASE STRATEGY	LOCATION
03/28/95	CH	H x W	249,856	AD + CWT	ACC	Imnaha Acclimation Pond (RK 74.0)
03/28/95	CH	H x W	77,269	AD + CWT	DSR	Imnaha Acclimation Pond (RK 74.0)
04/06/95	CH	H x H	80,143	ADLV	ACC	Imnaha Acclimation Pond (RK 74.0)
04/24/95	CH	H x W	67,130	AD + CWT	DSR*	Imnaha Acclimation Pond (RK 74.0)
04/26/95	CH	H x H	76,416	ADLV	ACC*	Imnaha Acclimation Pond (RK 74.0)
05/05/95	CH	H x H	39,255	LV	ACC*	Imnaha Acclimation Pond (RK 74.0)
TOTAL			590,069			
04/28/95	RBT	H	50,676	AD	DSR	Imnaha River @ Fence Creek (RK 24.6)
05/01/95	RBT	H	175,183	AD	PRO	Little Sheep Creek Acclimation Pond (RK 8.0)
05/01/95	RBT	H	55,699	ADLV + CWT	ACC	Little Sheep Creek Acclimation Pond (RK 8.0)
05/01/95	RBT	H	56,954	ADLV + CWT	DSR	Little Sheep Creek Acclimation Pond (RK 8.0)
TOTAL			338,512			

Fin Marks	Release Strategy
AD = Adipose Fin	ACC = Acclimated
LV = Left Ventral Fin	DSR = Direct Stream Release
CWT = Coded Wire Tag	PRO = Production

* Delayed release due to IHN outbreak.

Table G.2. Releases of chinook salmon parr (~~HxH~~ crossed) by ODFW and the Nez Perce Tribe in the Imnaha River drainage, 1994.

Date	Stream	Location	Number of Fish
July 19	Big Sheep Creek	Wallowa Mountain Loop Road and Road 140 Spur Bridge	91,112
July 20	Big Sheep Creek	3 sites RM 21-27	80,220
July 20	Little Sheep Creek	4 sites RM O-12	15,180
July 21	Freezeout Creek	lower 1/2 mile	7,614
July 21,25	Imnaha River	3 sites RM 33-43	36,240
July 22	Cow Creek ^a	4 sites RM I-5	24,260
July 22	Horse Creek	5 sites RM I-5	24,160
July 22	Lightning Creek	8 sites RM O-10	24,260
TOTAL			283,046

^a Confluence with the Imnaha River is below the Imnaha River screw trap site.